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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART I.—Atlantic Coast of New England Drainage

BY

H. K. BARROWS and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART I.

By H. K. Barrows and John C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Stat. L., vol. 28, p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. There is also collected information concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely upon the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes to show the conditions existing through long periods. They are also used as primary stations, and their records in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The Report of Progress of Stream Measurements, which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware River drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin River drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based upon the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided and the facts have been arranged as far as practicable geographically.

List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor Northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor Southern Atlantic.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor Eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor Western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharge," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-foot. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the two remaining columns, which are defined above, are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25, .125, .012, .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second, equals 448.8 gallons per minute, equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile, equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equals 15 United States gallons per second.
100 California miner's inches equals 77 Colorado miner's inches.
100 California miner's inches for one day equals 4 acre-feet.
100 Colorado miner's inches equals 2.60 second feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 130 California miner's inches.
100 Colorado miner's inches for one day equals 5.2 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.44 acre-feet.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards, equals 5,280 feet, equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet, equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.

1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch, equals 1 ton per square foot, equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.
To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\, h^{\frac{3}{2}}$; l = length of weir in inches; h = head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:

Scale 1: 125000, 1 mile=0.50688 inch.
Scale 1: 90000, 1 mile=0.70400 inch.
Scale 1: 62500, 1 mile=1.01376 inches.
Scale 1: 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data upon which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n, which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible

where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams, dams, or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as "equipment." These are: A gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge, or a tagged line indicating the points of measurement, and where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the

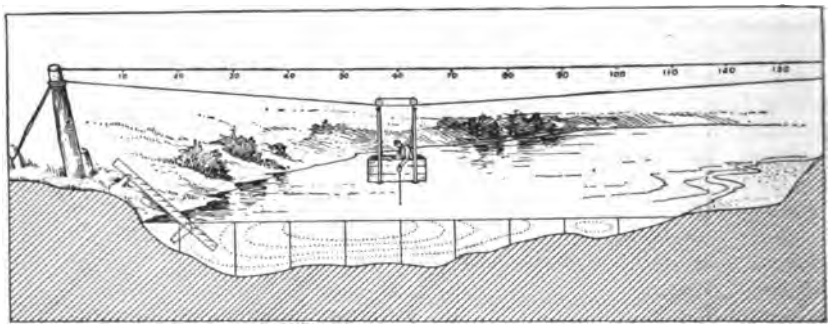

FIG. 1.—Cable station, showing section of river, car, gage, etc.

most satisfactory surface floats, and it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at

different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading; and gaging stations may be classified in accordance with such use. (Fig. 1 shows a typical cable station.)

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying grom 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are—the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, 4 times the mid depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice

the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to the lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

For stations on streams with permanent beds, the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to

any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

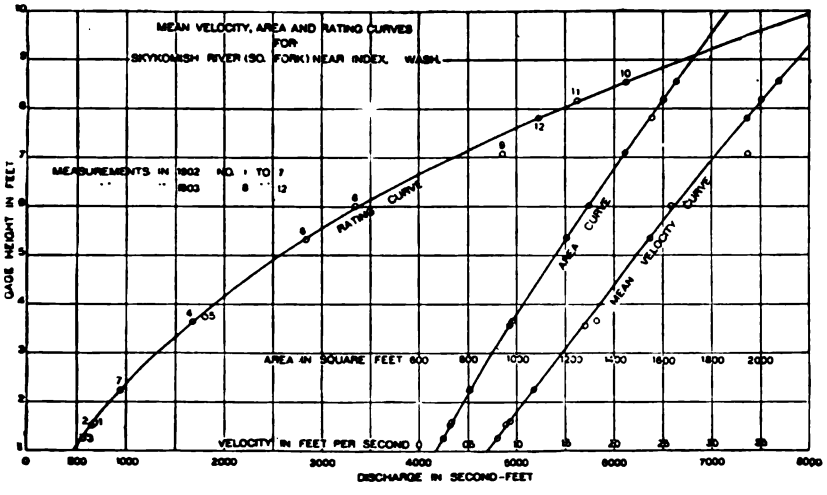

FIG 2.—Discharge, area, and mean velocity curves for South Fork of Skykomish River near Index, Wash.

The construction of the rating table depends upon the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be therefore a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are, therefore, constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station, the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographer and others who have assisted in furnishing and preparing the data contained in this report:

Connecticut.—District hydrographer, H. K. Barrows, assisted by T. W. Norcross. Acknowledgment should be made to Edwin D. Graves, chief engineer of the Connecticut River bridge and highway district, for gage heights of Connecticut River near Hartford; to Ransome & Hoadley, of Providence, R. I., and to E. W Crocker, of Leesville, Conn., for assistance in procuring data of flow of Salmon River at Leesville, Conn.

Maine.—District hydrographer, H. K. Barrows, assisted by F. E. Pressey and C. R. Adams. Acknowledgments should be made to the Bangor and Aroostook Railroad for annual passes issued to H. K. Barrows and F. E. Pressey, and for occasional trip passes for other men; to the Somerset Railroad for annual passes issued to H. K. Barrows and F. E. Pressey; to the Maine Central Railroad for annual pass good between Portland and Vanceboro, issued to F. E. Pressey; to the Washington County Railroad for annual pass issued to F. E. Pressey; to the Portland and Rumford Falls Railroad for trip passes issued when desired. Thanks are due to the following individuals and corporations

for data furnished and assistance rendered: H. S. Ferguson, engineer of the Great Northern Paper Company, for furnishing data on the flow of Penobscot River at Millinocket; H. C. Lord, of East Holden, for gage readings of Phillips Lake; Hollingsworth & Whitney Company, of Winslow, through James L. Dean, their engineer, for records of flow of the Kennebec at Waterville; the Chase Manufacturing Company at Waterville for the use of their dam on Messalonskee River for measurement purposes; S. D. Warren & Co., through Jos. A. Warren, of Cumberland Mills, for records of flow of the Cobbosseecontee and Presumpscot; C. A. Mixer, engineer of the Rumford Falls Power Company, for records of flow of Androscoggin River at Rumford Falls.

Massachusetts.—District hydrographer, H. K. Barrows, assisted by T. W. Norcross. Acknowledgments should be made to the Boston and Albany Railroad for trip passes issued to H. K. Barrows and T. W. Norcross; to the Boston and Maine Railroad for trip passes issued to H. K. Barrows and T. W. Norcross; R. A. Hale, principal assistant engineer of the Essex Company, Lawrence, for records of flow of Merrimac River at that point; Frederic P. Stearns, chief engineer of the Metropolitan Water and Sewerage Board, for records of flow of Sudbury and Nashua rivers and Lake Cochituate; the George H. Gilbert Manufacturing Company, of Ware, for assistance in procuring records of flow of Ware River at Gilbertville; the George H. Gilbert Manufacturing Company and the Otis Company, of Ware, for assistance in maintaining a gaging station at Ware; John T. F. MacDonnell, of Holyoke, for the use of the dam at West Warren for measurement purposes; the State board of health, through X. H. Goodnough, chief engineer, and W. S. Johnson, assistant engineer, for records of flow of Quaboag River during 1903; the West Ware Paper Company, through Dwight Holland, manager, for assistance in procuring data on Swift River at West Ware; the water department of the city of Springfield, through E. E. Lochridge, engineer, for assistance and cooperation in making measurements of flow of Westfield Little River.

New Hampshire.—District hydrographer, H. K. Barrows, assisted by F. E. Pressey and T. W. Norcross. Acknowledgments should be made to the Maine Central Railroad for annual passes in New Hampshire issued to H. K. Barrows and T. W. Norcross; to the Boston and Maine Railroad for trip passes issued to H. K. Barrows and T. W. Norcross; Walter H. Sawyer, agent of the Union Water Power Company, Lewiston, Me., for assistance in procuring records of flow of Androscoggin River at Errol dam and for other data concerning Androscoggin River; the Manchester Traction Light and Power Company, J. Brodie Smith, manager, through Hollis French, of French & Hubbard, Boston, for data regarding flow of the Merrimac at Garvins Falls; also to G. G. Shedd, resident engineer for French & Hubbard, for assistance rendered.

Rhode Island.—District hydrographer, H. K. Barrows, assisted by T. W. Norcross.

Vermont—District hydrographer, H. K. Barrows, assisted by T. W. Norcross. Acknowledgments should be made to Profs. A. D. Butterfield and G. M. Brett, of the University of Vermont, for assistance rendered; to the Boston and Maine Railroad for trip passes issued to H. K. Barrows and T. W. Norcross; to the Montpelier and Wells River Railroad, the Rutland Railroad, and the St. Johnsbury and Lake Champlain Railroad for annual passes issued to H. K. Barrows.

ST. JOHN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

St. John River drains the largest basin between St. Lawrence River on the north and Susquehanna River on the south. Its total drainage area is stated by Wells [a] to be 26,000 square miles, of which approximately 7,500 square miles lie in Maine, its basin occupying the whole northern portion of the State. The extreme headwaters lie in the mountainous region between Maine and Canada, at elevations of 1,500 and 2,000 feet; thence its waters flow at first generally northeastward through Maine. From the point of junction of the northwest and southwest branches, where the river first takes its name, to its junction with St. Francis River, a distance of 90 miles, its course lies wholly in Maine, though a portion of the tributary area lies in Canada. In this distance Alleguash River is the only tributary of importance. Wells estimates the average slope in the 90 miles to be 1.6 feet per mile. From its junction with St. Francis River the St. John forms the northern boundary of Maine for 70 miles. Within this distance the slope is slightly greater than above, having been estimated at 2.7 feet per mile, while the volume is considerably augmented by two important tributaries—Fish River from the south and Madawaska River from the north. At the point where it leaves the State line the river has an elevation of about 420 feet above sea level and drains an area of 8,765 square miles, of which

[a] Wells, Walter, The water power of Maine, 1869.

4,670 square miles are in Maine and 4,095 square miles in Canada. Beyond this point it receives the waters of Aroostook and Meduxnekeag rivers, the basins of which are almost entirely in Maine, besides several smaller tributaries having their sources, and in some cases a large portion of their drainage basins in the same State.

The underlying rock is generally deep and either calcareous or clay slate. The basin is well forested; large areas have never been touched by the ax, while other portions have been lumbered for pine only. Probably 85 to 90 per cent of the whole basin tributary to the river at the eastern boundary of Maine is in forest.

According to Wells, the ponds and lakes in this basin in Maine aggregate a total surface area of 314 square miles. Of this water surface 120 square miles, or 38 per cent, are tributary to Alleguash River (36 square miles of which have been diverted to Penobscot River); 60 square miles, or 19 per cent, are tributary to Aroostook River; and 80 square miles, or 25 per cent, are tributary to Fish River. At the outlets of several of these lakes dams have been built which store water to be used in transporting logs.

Prior to 1845 a canal was cut from Telos Lake, in the Alleguash basin, to Webster Lake, in the Penobscot basin, and a dam was constructed between Chamberlain and Eagle lakes. Thus, by means of these artificial structures, Chamberlain Lake, with its drainage basin of 270 square miles, was made tributary to the Penobscot. This diversion of St. John water is still continued. During the log-driving season, which varies considerably in its duration, nearly all of the run-off from this area is thrown to the Penobscot, while during the remainder of the year the gates in the dam at Chamberlain Lake are opened and water is allowed to flow both ways. On account of the fact that the gates in the dam at the outlet of Chamberlain Lake are about 2 feet lower than those in the dam at Telos Lake, the flow from this basin to the St. John is greater than that to the Penobscot when the gates in both are open. As the surface of the lake is lowered the proportion flowing to the St. John increases until at extreme low water none flows to the Penobscot.

Both the upper St. John and Alleguash rivers are generally inaccessible. The middle portion, forming the northern boundary of the State, may be reached on the Canadian side at any point by the Temiscouata Railway, or in Maine at Fort Kent and Van Buren by the Bangor and Aroostook Railroad, while the basins of Fish and Aroostook rivers are rendered easily accessible by means of the latter road. The drainage areas of the stream and its principal tributaries are as follows:

Drainage areas of St. John River and principal tributaries.

River.	Locality.	Area.
		Sq. miles.
St. John	Below Alleguash	4,320
Do	Fort Kent gaging station	5,280
Do	Eastern boundary of Maine	8,765
St. Francis	Mouth	580
Madawaska	do	1,085
Tobique	do	1,705
Alleguash	do	1,500
Fish	do	910
Do	Wallagrass gaging station	890
Aroostook	Mouth	2,350
Do	Fort Fairfield gaging station	2,230
Meduxnekeag	Mouth	520

ST. JOHN RIVER AT FORT KENT, ME.

This station was established October 13, 1905, by F. E. Pressey. It is located at the footbridge which crosses the St. John near Fort Kent post-office, a short distance above the point where Fish River enters the St. John. The drainage area at this point is 5,280 square miles.

The channel is straight for about 1,000 feet, both up and down stream. The bed is of gravel, rocky and permanent. Both banks are high, rocky, cleared, and not subject to overflow, except in extreme freshets. There are from one to four channels, depending on the stage of the river, and the river at ordinary stage is about 500 feet wide. The flow of the river at this point is entirely free, and there are no dams in this region. About 50 miles downstream are the Grand Falls, an important undeveloped water power.

Measurements of flow will probably be made from the upstream side of the footbridge, to which the gage is attached. The initial point for soundings will probably be the river edge of the left abutment.

The gage is an inclined staff 22 feet long, in two sections, attached to the concrete pier nearest the New Brunswick shore of the river. The lower part of the gage is placed in a groove in the side of the pier. The upper part is fastened to the downstream end of the same pier. The gage is read by A. J. Long. It is referred to bench marks as follows: (1) Copper bolt in bowlder on right bank, about 250 feet below the bridge; elevation, 12.99 feet. (2) Top of igneous rock on right bank about 200 feet below the bridge, marked "B. M. -2"; elevation, 12.64 feet. Elevations refer to datum of the gage.

Discharge measurement of St. John River at Fort Kent, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
Oct. 13[a]	F. E. Pressey	230	385	1.71	2.55	660

[a] Measured partly from a boat and partly by wading.

FISH RIVER AT WALLAGRASS, ME.

Fish River enters the St. John from the south at Fort Kent. It has a total drainage area of 910 square miles, all of which lies in Maine and 80 square miles of which are water surface. The basin is very generally wooded, probably 75 or 80 per cent of its area being still in forest. Of the several available power sites one only is partially developed and used for the manufacture of lumber. The underlying rock is shale or slate, and in general is well covered by soil.

The gaging station at Wallagrass was established July 29, 1903, by N. C. Grover. It is located just below the outlet of Wallagrass Brook.

The channel is straight for 500 feet above and 300 feet below the cable, and is about 100 feet wide. The bed is permanent and of gravel. The depth increases gradually from either bank to a maximum at low water of 3.5 feet near the center. The current at the measuring section is generally strong. The banks are high and are not liable to overflow.

Discharge measurements are made from a cable or by wading at low stages of the river.

A standard chain gage, which is read once each day by Vital E. Michaud, is attached to trees on the bank about 1,500 feet upstream from the cable. The length

of the chain is 39.75 feet. The gage is referred to bench marks as follows: (1) Copper bolt in ledge 600 feet downstream from gage; elevation, 11.73 feet. (2) Nail driven into blazed birch tree 5 feet upstream from gage; elevation, 11.91 feet. Elevations refer to datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 16-17; 124, pp 21-22.
Discharge: 97, p 17; 124, p 22.
Gage heights: 97, p 17; 124, p 23.

Discharge measurements of Fish River at Wallagrass, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 18	Barrows and Pressey	155	940	2.92	7.84	2,740
June 29	E. C. Murphy	146	540	1.80	4.83	970
August 30	F. E. Pressey	92	168	.50	2.00	84
October 10	do	90	152	.32	1.74	48

Daily gage height, in feet, of Fish River at Wallagrass, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			3.8	2.8	7.4	7.0	4.7		1.9			
2					7.5	6.8	4.7	2.8	1.9	2.0	2.0	
3					7.5	6.8	4.7	2.7				
4	3.5				7.6	6.7			2.0	2.0	2.0	
5					7.8	6.5	4.7	2.6				2.5
6				4.1	7.8	6.3			2.0	2.0	2.0	
7					8.3	6.3	4.6	2.6	2.0	1.8		
8		3.8			8.2	6.0	4.5				2.0	
9			3.9	4.6	8.1	6.0		2.6	2.0	1.8		
10					8.0	5.8	4.3		2.0		2.0	
11					7.9	5.9		2.5		1.8	2.0	
12	3.5				8.0	6.0	4.2	2.6	2.0			
13				5.8	8.0	6.2	4.0			1.7	2.0	
14			3.7		7.9	6.2		2.5	1.8	1.7	2.0	
15		3.9			7.8	6.2	3.8	2.4				
16				6.9	7.8	5.8			1.8	1.8	2.1	2.7
17				7.0	8.0	5.4	3.7	2.3				
18	3.5			7.1	7.9	5.4			1.8	1.8	2.1	
19				7.0	7.8	5.6	3.5	2.3	1.9	1.8		
20				7.0	7.4	5.6	3.5				2.1	
21				7.1	7.4	5.7		2.2	1.9	1.8		
22		3.9		7.1	7.5	5.6	3.4				2.1	
23				7.1	7.6	5.6		2.2	1.9	1.8	2.1	2.8
24			3.7	7.0	8.3	5.5	3.3	2.2		1.8		
25	3.4			7.0	8.0	5.3	3.1		1.9		2.2	
26				6.8	7.8	5.2		2.1	1.9	1.8		2.6
27				6.8	7.4	5.1	3.1					
28				7.0	7.4	5.0		2.0	1.9	1.8	2.2	
29			3.0	6.9	7.3	4.8	3.0					
30				7.0	7.3	4.8		2.0	1.9	1.8		
31	3.9				7.1		2.8			1.8		

Daily gage height, in feet, of Fish River at Wallagrass, Me., for 1905—Continued.

NOTE.—River frozen January 1 to March 23 and November 14 to December 31. For this period the readings were to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 4	3.5	3.8	1.3	March 9	3.9	3.9	0.2
January 12	3.5	3.7	1.3	March 14	3.7	3.8	.4
January 18	3.5	3.7	1.4	November 14	2.0	.....	.2
January 25	3.4	3.9	1.0	November 28	2.2	2.2	.1
January 31	3.9	.....	(a)	December 5	2.5	2.5	.1
February 8	3.8	.....	(a)	December 16	2.7	2.7	.1
February 15	3.9	4.1	.3	December 23	2.8	2.8	.1
February 22	3.9	4.0	.2	December 26	2.6	2.6	.4
March 1	3.8	3.9	.1				

a Ice thin.

Station rating table for Fish River at Wallagrass, Me., from July 29, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	47	3.40	429	5.20	1,167	8.40	3,174
1.80	59	3.50	462	5.40	1,268	8.60	3,328
1.90	72	3.60	496	5.60	1,372	8.80	3,487
2.00	86	3.70	531	5.80	1,479	9.00	3,650
2.10	102	3.80	567	6.00	1,590	9.20	3,817
2.20	120	3.90	604	6.20	1,705	9.40	3,988
2.30	139	4.00	642	6.40	1,824	9.60	4,162
2.40	159	4.10	681	6.60	1,946	9.80	4,339
2.50	180	4.20	721	6.80	2,071	10.00	4,520
2.60	203	4.30	762	7.00	2,200	10.50	4,999
2.70	227	4.40	803	7.20	2,331	11.00	5,490
2.80	252	4.50	845	7.40	2,464	11.50	6,000
2.90	279	4.60	888	7.60	2,599	12.00	6,550
3.00	307	4.70	932	7.80	2,738	12.50	7,100
3.10	336	4.80	977	8.00	2,880	13.00	7,650
3.20	366	4.90	1,023	8.20	3,025	13.50	8,250
3.30	397	5.00	1,070				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1903–1905. It is well defined throughout.

Estimated monthly discharge of Fish River at Wallagrass, Me., for 1903–1905.

[Drainage area, 890 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
August	681	366	484	0.544	0.627
September	366	139	242	.272	.304
October	139	86	93.6	.105	.121
November 1–29	279	102	204	.229	.247
1904.					
May	8,370	3,817	6,360	7.15	8.24
June	3,902	1,023	2,045	2.30	2.57
July	1,070	531	742	.834	.962
August	496	366	392	.440	.507
September	1,268	366	898	1.01	1.13
October	1,824	1,070	1,513	1.70	1.96
November	1,070	496	727	.817	.912
1905.					
April 16–30	2,265	2,071	2,151	2.42	1.35
May	3,099	2,265	2,761	3.10	3.58
June	2,200	977	1,514	1.70	1.90
July	932	252	597	.671	.774
August	252	79	158	.178	.205
September	86	59	74.3	.083	.093
October	86	47	62.8	.071	.082
November 1–13	86	72	84.9	.095	.046

NOTE.—Ice conditions November 30 to December 31, 1903, and during December, 1904. No estimate made from February 14 to April 30, 1904, on account of probable ice conditions. Discharge for 1905 interpolated on days when gage was not read. See table of gage heights.

AROOSTOOK RIVER AT FORT FAIRFIELD, ME.

Aroostook River enters the St. John from the west near Aroostook Junction, in the Province of New Brunswick. It has a total drainage area of 2,350 square miles, of which 2,320 square miles lie in Maine. Probably 80 per cent of the whole basin is in forest. The underlying rock is usually slate. Lake storage is used for driving logs only. Water power is used in Presque Isle. The principal falls on the river, known as Aroostook Falls, lie in Canada.

The gaging station was established July 31, 1903, by N. C. Grover. It is located at the steel highway bridge in the village of Fort Fairfield.

The channel is straight for at least 1,000 feet above and below the station, and is about 350 feet wide, broken by three piers. The bed is of gravel and permanent. The banks are high and not liable to overflow. The current is medium at low water and swift at high water.

Discharge measurements at all ordinary stages are made from the bridge to which the gage is attached. The initial point for soundings is on the right bank at the lower end of the inclined end post of the downstream truss. At low water discharge measurements are made by wading at a section a short distance below the bridge.

A standard chain gage, which is read twice each day by F. E. Petersen, is attached to the steel webbing of the upstream truss of the bridge. The length of the chain is 27.61 feet. The gage is referred to bench marks as follows: (1) Northwest corner of south abutment; elevation, 22.43 feet. (2) Marked point on connection plate near gage; elevation, 23.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 17-18; 124, pp 23-24.
Discharge: 97, p 18; 124, p 24.
Discharge, monthly: 124, pp 26.
Gage heights: 97, p 18; 124, pp 24-25.
Rating table: 124, pp 25.

Discharge measurements of Aroostook River at Fort Fairfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 15	Barrows and Pressey	397	1,660	3.67	6.67	6,090
June 27	E. C. Murphy	301	750	2.07	4.30	1,550
August 24	F. E. Pressey	241	355	.49	3.10	175
October 16 [a]	do	187	224	.52	2.96	117

[a] By wading about 900 feet below gage.

Daily gage height, in feet, of Aroostook River at Fort Fairfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1						5.85	4.2	3.5	3.05	3.1	3.1	
2						5.7	4.2	3.5	3.1	3.1	3.15	
3						5.65	4.3	3.5	3.1	3.15	3.3	
4		4.4	4.6			5.6	4.35	3.45	3.0	3.1	3.55	
5						5.65	4.3	3.35	3.15	3.1	3.85	
6						5.5	4.25	3.3	3.2	3.1	3.6	
7	4.1					5.3	4.2	3.25	3.15	3.05	3.45	
8						5.15	4.05	3.3	3.05	3.0	3.3	
9						4.95	3.7	3.2	3.1	3.0	3.3	3.6
10						4.65	3.85	3.3	3.1	3.0	3.4	
11		4.4	4.5			4.6	3.8	3.3	3.0	3.0	3.4	
12						4.6	3.75	3.3	3.0	3.05	3.4	
13						4.8	3.65	3.3	3.1	3.0	3.4	
14	4.3					5.05	3.65	3.4	3.05	3.0	3.4	
15						5.2	3.6	3.35	3.0	3.0	3.35	
16						5.15	3.55	3.3	3.0	3.0	3.4	3.5
17			4.7			4.95	3.6	3.3	3.0	3.0	3.4	
18		4.3				4.75	3.6	3.3	3.1	3.1	3.4	
19						4.8	3.55	3.3	3.1	3.0	3.4	
20			4.7			4.9	3.55	3.3	3.15	3.1	3.35	
21	4.4					5.05	3.6	3.3	3.15	3.1	3.45	
22						5.05	3.5	3.25	3.2	3.1	3.4	
23						4.95	3.5	3.2	3.2	3.1	3.4	3.7
24						4.75	3.5	3.15	3.1	3.1	3.4	
25		4.4				4.55	3.5	3.0	3.1	3.1	3.4	
26						4.5	3.5	3.1	3.15	3.1	3.4	
27			4.8			4.4	3.5	3.0	3.1	3.0	3.4	
28	4.4		5.1			4.4	3.5	3.05	3.2	3.1	3.1	
29			5.9			4.25	3.5	3.1	3.2	3.1	3.4	
30						4.2	3.45	3.1	3.15	3.1	3.4	
31							3.5	3.05		3.1		3.6

NOTE.—River was frozen January 1 to about April 1 and December 1-31. River frozen over above and below bridge November 21-30. During frozen period the readings were to the surface of the water in a hole cut in the ice.

The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 7	4.1	4.3	1.3
January 14	4.3	4.4	1.5
January 21	4.4	4.5	1.6
January 28	4.4	4.6	2.0
February 4	4.4	4.7	2.1
February 11	4.4	4.6	2.1
February 18	4.3	4.6	2.2
February 25	4.4	4.6	2.4
March 4	4.6	4.5	2.2
March 11	4.5	4.7	2.1
March 17	4.7	4.9	(a)
March 20	4.7	4.8	(a)
March 27	4.8	4.8	(a)
March 28	5.1	5.4	(a)
March 29	5.9	6.3	(a)
December 9	3.6	3.8	.6
December 16	3.5	3.7	.85
December 23	3.7	3.7	1.0
December 31	3.6	.....	1.1

a Ice unsafe.

Station rating table for Aroostook River at Fort Fairfield, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.90	95	4.60	1,984	6.30	5,275	9.00	12,600
3.00	130	4.70	2,150	6.40	5,495	9.20	13,240
3.10	180	4.80	2,320	6.50	5,715	9.40	13,900
3.20	240	4.90	2,494	6.60	5,940	9.60	14,560
3.30	310	5.00	2,672	6.70	6,165	9.80	15,230
3.40	390	5.10	2,854	6.80	6,395	10.00	15,910
3.50	480	5.20	3,040	6.90	6,630	10.20	16,600
3.60	580	5.30	3,230	7.00	6,865	10.40	17,300
3.70	690	5.40	3,423	7.20	7,345	10.60	18,000
3.80	810	5.50	3,619	7.40	7,840	10.80	18,700
3.90	940	5.60	3,818	7.60	8,360	11.00	19,400
4.00	1,075	5.70	4,019	7.80	8,910	11.50	21,200
4.10	1,215	5.80	4,222	8.00	9,500	12.00	23,000
4.20	1,360	5.90	4,427	8.20	10,100	12.50	24,850
4.30	1,510	6.00	4,635	8.40	10,710	13.00	26,700
4.40	1,664	6.10	4,845	8.60	11,330	13.50	28,600
4.50	1,822	6.20	5,060	8.80	11,960		

NOTE.—The above table is applicable only for open-channel conditions. It is based on fifteen discharge measurements made during 1903–1905. It is well defined throughout, and is the same as the 1904 curve above 6 feet. The 1903–4 rating table as published was very much in error below 3.4 feet. The above table is considered to give reasonably close results for low-water stages.

Estimated monthly discharge of Aroostook River at Fort Fairfield, Me., for 1905.

[Drainage area, 2,230 square miles.]

Month.	Discharge in second-feet.			Run-off	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
June	4,324	1,360	2,644	1.18	1.32
July	1,587	435	785	.352	.406
August	480	130	291	.130	.150
September	240	130	184	.083	.093
October	210	130	162	.073	.084
November [a]	875	180	390	.175	.195

[a] Estimates November 21-30 only approximate owing to ice above and below the gage.

ST. CROIX RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

St. Croix River is formed by two branches; one, known as the upper St. Croix or Chiputneticook River, is the outlet of Schoodic Lakes, the other, Kennebasis River, is the outlet of the western lakes of the area, known as Kennebasis Lakes. The upper St. Croix, with its tributary lakes, forms nearly half of the eastern boundary of Maine, separating that State from New Brunswick. The total drainage area of the main stream is about 1,630 square miles, of which 920 square miles are tributary to the great reservoir systems controlled by dams at Vanceboro and Princeton. The length of the stream from the headwaters to the mouth is 100 miles. The basin is, in general, lower than that of any of the larger streams of the State flowing into the Atlantic, its headwaters having an elevation of about 540 feet. The fall from Chiputneticook (the lower of the Schoodic Lakes) to tide water, a distance of 54 miles, is, however, 382 feet, or 7 feet to the mile. At a number of places, where falls and rapids occur, water power has been or can easily be developed.

The lake surface of the upper St. Croix is approximately 50 square miles and that of West Branch 70 square miles in area, taking into account only the principal lakes and ponds. Indeed, above Vanceboro and Princeton, each branch of the river is simply a succession of lakes to almost the extreme headwaters. Wells estimated the total lake surface of the St. Croix as not less than 150 square miles, or nearly one-tenth of the total basin. The drainage area at various points on the river is given in the following table:

Drainage area of St. Croix River.

	Square miles.
Main river:	
Vanceboro dam, foot of the Schoodic Lakes	420
Little Falls	500
Immediately above mouth of West Branch	690
Immediately below mouth of West Branch	1,360
Spragues Falls	1,390
At gaging station below Spragues Falls	1,420
Calais, lower dam	1,530
Mouth of river, eastern border of town of Calais	1,630
West Branch:	
Princeton dam	500
Confluence with main river	670

A large proportion of the drainage basin is still covered with timber, and above Vanceboro and Princeton the region is for the most part wild and inaccessible. The greater part of the timber land in this region is controlled by sawmill owners at Calais and St. Stephen. In 1898 the amount of lumber sawed annually had decreased from about 100 million feet to 25 million feet, and since then the number of saw-

mills has been greatly reduced. In 1901 the lumber sawed amounted to 28 million feet, showing that the rate of cutting has remained nearly constant during the last few years. There are on this stream favorable locations for paper and pulp mills, and during the present season the St. Croix Paper Company is developing the Spragues Falls privilege, where a 6,000-horsepower installation of wheels is being made to utilize a head of from 40 to 44 feet.

ST. CROIX RIVER AT SPRAGUES FALLS, NEAR BARING, ME.

This station was established December 4, 1902, by F. E. Pressey, and has been located until the present season a short distance above Spragues Falls, near Baring. A chain gage was attached to the lower guard timber of the Washington County Railway bridge. Measurements of flow were made from a car suspended from a cable about one-half mile above the bridge.

June 8, 1905, this gaging station was moved about 1½ miles downstream on account of the building of a paper mill and dam at Spragues Falls, which will cause backwater effect for several miles. The drainage area at the new location is 1,420 square miles.

The channel is straight for 1,000 feet above and 500 feet below the cable, and has an unbroken width of about 290 feet at ordinary stages. The bed of the stream is of gravel and rocks. The right bank is high and steep; the left bank is of medium height and may overflow at very high water. The current is strong at high stages and well sustained at low water. The nearest dam downstream is at Baring, a distance of about 4 miles.

Discharge measurements are made by means of a cable and car.

A vertical staff gage 5½ feet long is attached to a large bowlder on the left bank about 1 mile below the new dam at Spragues Falls and about 400 feet upstream from the cable. A standard chain gage has also been attached to an oak tree on the left bank about 300 feet above the staff gage for use during high water. The length of the chain is 11.20 feet. Gage heights are observed once each day by Simeon Phinney, of Baring. These gages are referred to bench marks as follows: (1) Copper bolt in bowlder to which staff gage is attached; elevation, 14.32 feet. (2) Nail driven horizontally into the north side of oak tree to which the chain gage is attached, about 1 foot above the ground; elevation, 17.30 feet. (3) Nail in branch of above-mentioned oak tree; elevation, 23.82 feet. All elevations refer to gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 14; 97, p 20; 124, pp 27-28.
Discharge: 97, p 20; 124, p 28.
Discharge, daily: 97, p 22.
Discharge, monthly: 97, p 23; 124, p 30.
Gage heights: 82, p 14; 97, p 21; 124, p 29.
Rating table: 97, p 21; 124, p 30.

Discharge measurements of St. Croix River at Spragues Falls, near Baring, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
		Feet.	*Sq. feet.*	*Ft. per. sec.*	*Feet.*	*Sec.-feet.*
April 11	F. E. Pressey	218	1,140	5.64	9.64	6,430
June 14	do	295	1,090	2.17	7.73	2,370
September 6	do	292	790	1.48	6.74	1,170
September 7	do	292	790	1.44	6.75	1,140
October 5	do	283	660	.97	6.23	640
November 20[b]	do	288	785	1.27	6.69	995

[a] Old gage used for measurement of April 11 and new gage used thereafter.
[b] Anchor ice probably affects results.

Daily gage height, in feet, of St. Croix River at Spragues Falls, near Baring, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.9	7.9	9.2	8.3	7.2	8.4	7.8	6.7	.....	6.0	6.2
2	6.8	7.9	7.9	.....	8.3	7.2	.....	7.5	6.6	6.3	6.0	6.2
3	6.8	7.9	8.0	9.3	8.2	7.2	8.8	7.4	.....	6.3	6.0	.....
4	6.9	7.9	8.0	9.2	8.2	.....	9.0	7.4	6.7	6.3	6.0	8.4
5	6.9	.....	.....	8.9	8.2	7.2	9.0	.....	6.7	6.3	.....	8.4
6	6.9	7.9	8.0	8.9	8.2	.....	8.9	.....	6.7	6.3	6.2	8.4
7	6.8	7.9	7.9	9.1	.....	7.2	8.8	7.3	6.7	6.3	6.2	8.4
8	.....	7.9	7.9	9.3	7.8	7.2	8.7	7.2	6.7	.....	6.2	8.0
9	7.5	7.9	7.9	.....	7.8	7.2	.....	7.2	6.7	6.2	6.3	8.0
10	7.5	7.9	7.9	9.7	8.4	7.1	8.5	7.1	.....	6.1	6.3	.....
11	7.5	7.9	7.9	9.7	8.5	.....	8.5	7.1	6.7	6.1	6.3	.....
12	7.5	.....	.....	9.7	8.6	7.5	8.5	7.1	6.7	6.1	.....	.....
13	7.5	.....	7.9	9.6	.....	7.7	8.4	.....	6.7	6.1	6.3	.....
14	.....	7.9	7.9	9.7	.....	7.6	8.3	7.0	6.8	6.1	6.3	9.2
15	.....	7.9	7.9	9.7	9.0	7.6	8.1	7.0	6.8	.....	6.2	9.2
16	7.5	7.9	7.9	9.7	9.0	7.6	.....	7.0	6.7	6.0	6.2	9.2
17	7.5	7.9	7.9	9.6	7.8	7.6	8.0	7.0	.....	6.0	6.6	.....
18	7.5	7.9	7.9	9.3	9.0	.....	8.0	7.0	6.6	6.0	6.7	.....
19	7.5	.....	.....	8.7	8.0	8.4	8.0	7.0	6.6	6.0	.....	.....
20	7.6	7.9	7.8	8.7	8.0	8.5	8.1	.....	6.6	6.0	6.9	6.7
21	7.6	7.9	7.8	8.8	7.8	8.6	8.1	6.9	6.6	6.0	6.9	6.7
22	.....	7.9	7.8	8.9	7.8	8.6	8.1	6.8	6.6	.....	6.9	7.3
23	7.6	7.8	7.8	.....	7.7	8.6	.....	6.8	6.6	6.0	6.5	.....
24	7.6	7.8	7.7	9.4	7.6	8.6	8.1	6.8	.....	6.0	6.5	.....
25	7.6	7.8	7.7	9.1	7.4	.....	8.1	6.8	6.5	6.0	6.5	.....
26	7.6	.....	.....	8.6	7.4	8.6	8.2	6.8	6.4	6.0	.....	.....
27	.....	7.8	8.0	8.3	7.4	8.6	8.1	.....	6.4	6.0	6.4	.....
28	.....	7.9	8.0	8.1	.....	8.6	8.1	6.7	6.3	6.0	6.3	7.3
29	.....	.....	8.0	8.1	7.2	8.6	8.1	6.7	6.3	.....	6.2	7.3
30	7.9	.....	8.2	.....	7.2	8.6	.....	6.7	6.3	6.0	6.2	7.3
31	7.9	.....	8.9	.....	7.2	.....	8.0	6.7	.....	6.0	.....	.....

NOTE.—Gage heights from January 1 to June 30 are for old gage at railroad bridge and are used with rating table for that point. After July 1 gage heights are for gage in new position, for which a rating table is not yet prepared.

River frozen January 1 to March 31 and December 14–31. During frozen season gage heights are to the surface of the water in a hole cut in the ice. The following measurements of thickness of ice were made: December 14–16, 0.3 foot; December 20–22, 0.6 foot; December 28–30, 1.3 feet.

Station rating table for St. Croix River at Spragues Falls, near Baring, Me., from December 4, 1902, to June 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	555	7.00	1,225	8.00	2,380	9.00	4,090
6.10	585	7.10	1,330	8.10	2,510	9.10	4,340
6.20	620	7.20	1,440	8.20	2,640	9.20	4,605
6.30	660	7.30	1,550	8.30	2,775	9.30	4,880
6.40	710	7.40	1,660	8.40	2,920	9.40	5,160
6.50	770	7.50	1,775	8.50	3,075	9.50	5,450
6.60	840	7.60	1,890	8.60	3,245	9.60	5,750
6.70	925	7.70	2,010	8.70	3,430	9.70	6,055
6.80	1,020	7.80	2,130	8.80	3,635		
6.90	1,120	7.90	2,255	8.90	3,855		

NOTE.—The above table is applicable only for open channel conditions. It is based on 1903 and 1904 discharge measurements. It is fairly well defined between gage heights 6 feet and 7.5 feet. Above gage height 7.5 feet it is unreliable.

Estimated monthly discharge of St. Croix River at Spragues Falls, near Baring, Me., for 1905.[a]

[Drainage area, 1,390 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	6,055	2,510	4,531	3.26	3.64
May	4,090	1,440	2,494	1.79	2.06
June	3,245	1,330	2,267	1.63	1.82

[a] Discharge interpolated on days when the gage was not read.

MACHIAS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Machias may be taken as fairly representative of several of the smaller streams of Maine which empty their waters directly into the ocean and which are commonly referred to as "coastal rivers." Its total drainage basin is 495 square miles, nearly all of which lies in Washington County, Me. Its extreme headwaters lie at an elevation of nearly 500 feet, and are not more than 50 miles from tide water. Wells listed 20 lakes in this basin, aggregating 29.5 square miles in area of water surface. Without important exception these lie, however, in the extreme headwaters. Dams are maintained at several of the outlets of the lakes, and the stored water is used for log driving.

The underlying rock is usually granite. Probably 70 to 80 per cent of the basin is still in forest.

MACHIAS RIVER NEAR WHITNEYVILLE, ME.

This gaging station was established October 17, 1903, by F. E. Pressey, at the bridge of the Washington County Railway, near Whitneyville. The drainage area at this point is 465 square miles.

A short distance above the station is a dam which stores water for use by the mills in Machias. The gates in this dam are opened and closed each day during low stages of the river. As a result the river fluctuates as much as 0.5 foot on the gage. Backwater effect occurs during a considerable portion of the time, owing to the influence of the dam at Machias, about 4 miles below, or to the accumulation of logs, and the gage heights are consequently unreliable. The water is confined to one channel at all stages; the width is about 130 feet. The bed is sandy, but permanent.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is on the left bank at the lower end of the inclined end post of the downstream truss. Low-water measurements may be made by wading at a point 200 feet above the bridge at low stages of the river.

A standard chain gage, which is read twice each day by George McKenzie, is attached to the guard timber on the downstream side of the bridge. The length of the chain is 25.34 feet. The gage is referred to bench marks as follows: (1) Copper bolt in outcropping ledge on upstream side of railroad track, 170 feet from the face of the left abutment; elevation, 20.12 feet. (2) Downstream outer corner of bridge seat of right abutment; elevation, 18.05 feet. (3) Marked point on floor beam of bridge at zero end of gage; elevation, 23.89 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 24; 124, p 31.
Discharge: 97, p 24; 124, p 32.
Discharge, monthly: 124, p 33.
Gage heights: 97, p 24; 124, p 32.
Rating table: 124, p 33.

Discharge measurements of Machias River near Whitneyville, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 13	Barrows and Pressey	124	715	1.39	7.49	992
June 15[a]	F. E. Pressey	125	1,000	1.34	9.57	1,340
September 8	do	125	770	1.30	7.88	1,000
October 3	do	124	560	.38	6.18	210
November 21	do	124	585	.74	6.47	430

[a] River filled with logs below station.

Daily gage height, in feet, of Machias River, near Whitneyville, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.2	.....	.....	13.2	8.8	8.4	7.5	7.0	5.2	6.3	6.0	6.3
2	.....	.....	7.1	12.6	8.6	8.6	7.5	7.2	5.4	5.8	6.5	6.1
3	.....	7.2	.....	11.4	8.2	8.9	8.2	6.9	5.9	5.9	7.0	7.4
4	.....	.....	.....	10.6	8.1	9.3	9.2	6.7	6.6	5.9	6.9	9.6
5	6.5	.....	.....	9.9	8.1	9.2	8.8	6.4	6.8	5.7	7.0	10.1
6	.....	.....	.....	10.2	7.7	9.2	8.1	6.5	7.3	5.5	7.0	7.8
7	6.8	.....	.....	11.8	7.6	9.8	7.7	6.4	8.3	5.4	7.3	7.1
8	8.2	.....	.....	12.5	7.7	9.8	7.6	6.1	7.8	5.6	7.7	6.3
9	8.7	.....	.....	11.8	7.7	9.8	7.4	6.2	7.4	5.6	7.6	5.6
10	8.5	7.0	7.1	11.2	8.0	9.8	7.2	5.8	7.0	5.5	7.4	6.1
11	8.2	.....	.....	10.9	8.0	9.5	7.2	6.1	6.8	5.5	7.2	6.3
12	8.1	.....	.....	11.0	7.6	9.6	7.3	6.0	6.4	5.7	6.6	6.1
13	8.0	.....	.....	11.1	7.5	10.0	7.2	6.3	6.6	5.6	6.6	6.1
14	8.0	.....	.....	11.1	7.8	9.9	7.0	6.2	7.2	5.6	6.7	.....
15	7.9	.....	.....	11.2	7.6	9.6	6.8	6.1	7.4	6.1	6.8	.....
16	7.8	.....	6.8	11.3	7.8	9.3	7.0	5.9	7.0	5.9	6.6	.....
17	.....	7.3	.....	10.8	8.7	9.0	7.8	6.0	7.0	6.0	7.6	.....
18	.....	.....	.....	9.4	9.4	8.8	7.8	6.0	6.7	5.8	7.6	.....
19	.....	.....	7.2	9.0	9.2	8.5	6.8	6.0	6.6	5.6	7.3	.....
20	7.6	.....	7.4	8.6	8.9	8.4	6.8	5.9	6.8	5.9	6.9	.....
21	.....	.....	7.6	8.5	8.4	8.6	6.7	6.4	6.8	5.6	6.7	.....
22	.....	.....	7.5	9.0	7.8	8.3	6.6	6.3	6.6	6.3	6.4	.....
23	7.2	.....	7.4	9.6	7.4	8.1	6.7	6.2	6.5	6.1	6.6	.....
24	.....	.....	7.5	9.5	7.1	7.9	6.7	6.1	6.6	5.8	6.8	.....
25	.....	7.1	7.6	9.3	6.8	7.6	6.7	5.9	6.6	5.8	6.7	.....
26	.....	.....	8.3	9.2	6.6	7.5	6.5	5.8	6.6	5.7	6.7	.....
27	.....	.....	9.2	9.2	6.6	7.7	6.4	5.4	6.6	5.8	6.6	.....
28	.....	.....	9.9	9.0	6.4	8.1	6.5	5.7	6.4	5.8	6.4	.....
29	.....	.....	10.4	8.4	6.4	8.0	6.4	5.7	6.0	5.5	5.2	.....
30	7.2	.....	11.0	8.7	6.4	7.8	6.6	5.9	6.1	5.4	6.2	.....
31	.....	.....	12.5	.....	7.2	.....	6.7	5.8	.....	5.4	.....	.....

Daily gage height, in feet, of Machias River, near Whitneyville, Me., for 1905—Cont'd.

NOTE.—River frozen January 1 to March 31 and December 14-31. During frozen period gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	6.2	6.3	1.2
January 16	7.8	8.2	1.2
January 20	7.6	8.0	1.4
January 23	7.2	7.4	1.4
January 30	7.2	7.4	2.05
February 3	7.2	7.4	2.05
February 10	7.0	7.15	2.15
February 17	7.3	7.5	1.9
February 25	7.1	7.3	1.8
March 2	7.1	7.3	1.6
March 10	7.1	7.2	.7
March 16	6.8	7.0	1.15
March 23	7.4	7.4	1.25
March 31		River clear of ice.	

April 1-17, jam of logs in river. April 18, log jam broken; gage height fell 1.3 feet in three hours.

PENOBSCOT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Penobscot basin, which has a total area of about 8,500 square miles, lies wholly in Maine. It extends from the Atlantic Ocean on the south to the basin of the St. John on the north, a distance of 160 miles, and from the New Brunswick boundary on the east to the Quebec boundary on the west, a distance of 115 miles. The general elevation of the basin is lower than that of the drainage basins to the west. The headwaters of the main river lie in the mountainous region on the boundary of Quebec, at an elevation of nearly 2,000 feet. The slopes of the upper tributaries are generally steep. Chesuncook Lake lies near the center of the basin at an elevation of 930 feet. From this point to tide water the distance along the river is about 121 miles, indicating an average slope of 7.7 feet to the mile. This is concentrated at intervals by ledges where water power has been or may be developed. The water from about 800 square miles of the basin is discharged into the main river below its lowest available water power at Bangor.

Taken as a whole, the basin is rather uniform in its topographic features. Hills and low mountains stretch from near the sea to above Bangor; farther north is an undulating plain, while to the west the surface becomes more broken and is greatly diversified by hills, detached peaks, lakes, ponds, and swamps. At the south the basin merges into that of the Kennebec, and at the north into that of the Alleguash, terminating on the northwest, at the boundaries of the State, in a region of highland intermingled with swamps and lagoons. The whole northern basin of the main river and its tributaries is in forest. Original growth covers a large portion of this area, and in general, wherever cuttings have been made, a dense second growth has sprung up. Extensive areas in the southern basin have been cleared and converted into farms. Probably 70 to 80 per cent of the whole basin above Bangor is in forest. Throughout the upper portion of the basin slate is the principal outcropping rock, being succeeded to the east and south by schists, gneiss, and granite. The soil is mainly clay, gravel, and loam.

Surveys have been made in the Penobscot River drainage basin by the United States Geological Survey as follows: In 1904, plan and profile of Penobscot River

between tide water and Twin Lake at Norcross; in 1905, plan and profile of West Branch of Penobscot River from Chesuncook Lake to Seboomook.

The drainage area of the river and its chief tributaries are given in the following table:

Drainage areas of Penobscot River and principal tributaries.

River.	Locality.	Area.
		Sq miles.
Penobscot	Opposite northwest extremity of Moosehead Lake, township of Seboomook, immediately below mouth of Nulhedus Creek.	510
Do	Entrance into Chesuncook Lake	850
Do	Outlet of Chesuncook Lake	1,450
Do	Millinocket, outlet of Twin Lakes	1,880
Do	Immediately below mouth of East Branch of Penobscot [a]	3,260
Do	Immediately below mouth of Mattawamkeag [a]	4,940
Do	West Enfield, at gaging station immediately below mouth of Piscataquis [a]	6,630
Do	Sunk Haze Rips [a]	7,260
Do	Old Town, above mouth of Pushaw River [a]	7,340
Do	Bangor, above mouth of Kenduskeag River [a]	7,720
Do	Mouth [a]	8,550
Canquomogomoc	Entrance into Chesuncook Lake	230
East Branch of Penobscot	Grindstone at gaging station [a]	1,130
Do	Mouth [a]	1,160
Mattawamkeag	Immediately below outlet of Baskahegan Lake	190
Do	At gaging station near mouth	1,510
Piscataquis	Low's bridge	280
Do	Dover	330
Do	Mouth	1,500
Passadumkeag	do	400
Cold Stream	do	37
Do	At gaging station near Enfield post-office	26
Phillips Lake outlets:		
Northern outlet	Junction with Phillips Lake	11.5
Do	East Holden, at gaging station	12.3
Phillips Lake		[b] 1.4

[a] Includes Chamberlain Lake basin (270 square miles). See description of St. John River drainage basin.
[b] Area of water surface.

PENOBSCOT RIVER AT MILLINOCKET, ME.

The discharge of Penobscot River at Millinocket has been computed and the data furnished by H. S. Ferguson, engineer for the Great Northern Paper Company. These results were obtained by considering the flow through the wheels, the flow over the dam, and such quantities of water as are used from time to time by the log sluice, filters, etc. The wheels were rated at Holyoke, Mass., before being placed in position. As the head under which they work, averaging about 110 feet, is much greater than the head under which they were tested, numerous tube-float measurements of flow in the canal leading to the mill have been made by Mr. Ferguson, in order to determine just how much water the mill used under different conditions of gate openings. In addition to this, during 1904 a series of current-meter measurements were made by the United States Geological Survey, to check results as obtained by the floats and to obtain a suitable coefficient for use with the float measurements. It is believed that by means of these various checks on the measurements

a very good estimate has been made for the flow through the wheels. The dam, known as Quakish Lake dam, is of concrete, resting on rock, and does not leak. The flow over it was computed by use of the formula $Q=c\,b\,h^{\frac{3}{2}}$, in which c is a variable coefficient obtained (1) from the results of weir measurements made by Mr. Ferguson on a 10-foot portion of the dam, and (2) from a study of the results of experiments made by George W. Rafter at the Cornell testing flume.

When the flow of the river is less than 2,500 second-feet all of the water is generally used through the mill; at higher stages the excess is wasted over the dam. The flow over the flashboards, which are used whenever possible, is computed by use of the formula $Q=3.33\,b\,h^{\frac{3}{2}}$. Several dams which have been constructed at points in the basin above this mill store water on a surface of practically 80 square miles. This water is used for log driving and for manufacturing purposes. Quakish Lake dam is at an elevation of 456.3 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 19; 97, pp 26–27; 124, p 36.
Discharge, daily: 82, pp 19–20; 97, p 27; 124, p 37.
Discharge, monthly: 82, p 21.

Daily discharge, in second-feet, of Penobscot River at Millinocket, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,235	2,122	2,577	1,299	2,504	8,906	2,063	4,712	2,395	2,235	428	452
2	2,396	2,132	2,108	1,018	2,548	7,372	3,922	4,817	2,392	2,510	453	451
3	2,143	2,137	2,119	1,278	2,521	2,553	2,627	4,971	2,300	2,505	437	332
4	2,125	1,970	2,181	1,287	2,519	2,448	2,300	4,981	2,207	2,420	437	452
5	2,145	2,355	2,266	1,282	2,532	2,088	2,738	4,607	2,200	1,993	348	453
6	2,161	2,142	2,190	1,685	2,536	2,109	2,677	4,077	2,352	2,080	439	448
7	2,163	2,150	2,129	2,106	2,329	2,094	2,046	4,294	2,356	2,088	437	457
8	2,186	2,151	2,020	2,119	2,523	2,110	2,044	4,766	2,381	1,965	438	456
9	2,165	2,151	1,965	2,152	2,529	2,105	2,054	5,297	2,086	2,081	444	445
10	2,174	2,063	1,972	2,138	2,524	2,093	2,058	4,393	2,063	2,091	440	315
11	2,595	2,524	1,987	2,426	2,527	2,463	3,599	2,232	2,068	2,095	456	435
12	2,155	2,465	1,883	2,544	6,185	2,416	2,063	2,028	2,075	2,090	359	408
13	2,145	2,158	1,968	2,545	6,658	2,094	2,066	2,111	2,072	2,098	470	440
14	2,140	2,169	1,960	2,540	5,646	2,524	2,061	2,234	2,068	2,090	465	444
15	2,254	2,160	1,198	2,542	7,187	2,111	2,061	2,074	2,070	1,970	455	436
16	2,318	2,174	2,201	2,625	7,186	2,104	2,855	2,358	2,072	2,070	462	427
17	2,113	2,157	2,039	2,575	7,107	2,085	2,322	3,285	1,944	1,661	424	303
18	2,165	2,032	1,728	2,528	7,660	2,367	2,045	3,159	2,415	1,656	450	425
19	2,165	2,232	1,125	2,535	8,492	2,092	2,035	3,170	2,420	1,663	343	431
20	2,191	2,143	1,368	2,516	8,378	2,088	2,015	2,595	2,090	1,411	470	432
21	2,169	2,163	1,266	2,526	8,844	2,058	2,058	2,253	2,500	716	453	432
22	2,463	2,169	1,279	2,482	8,181	2,066	2,048	2,051	2,488	358	464	428
23	2,475	2,164	1,264	2,376	7,619	2,078	2,343	2,064	2,495	430	456	425
24	2,169	2,192	1,290	2,460	7,800	2,477	2,348	2,048	2,505	421	443	173
25	2,141	2,163	1,787	2,530	8,006	2,477	2,084	2,037	2,510	422	445	140
26	2,137	2,273	1,038	2,521	9,078	2,070	2,068	2,050	2,508	429	364	428
27	2,545	2,191	1,305	2,516	8,862	3,570	2,053	2,042	2,522	430	424	438
28	2,066	2,164	1,296	2,509	9,435	1,973	2,058	2,180	2,520	441	356	444
29	2,165	.....	1,308	2,527	9,330	2,476	2,057	2,034	2,522	355	448	444
30	2,425	.....	1,280	2,429	9,171	2,491	3,283	2,036	2,510	435	441	449
31	2,133	.....	1,299	.....	9,059	.....	4,184	2,227	.....	438	.....	444

Estimated monthly discharge of Penobscot River at Millinocket, Me., for 1905.

[Drainage area, 1,880 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,595	2,066	2,226	1.18	1.36
February	2,524	1,970	2,181	1.16	1.21
March	2,577	1,038	1,722	.916	1.06
April	2,625	1,018	2,221	1.18	1.32
May	9,435	2,329	6,047	3.22	3.71
June	8,906	1,973	2,665	1.42	1.58
July	4,184	2,015	2,395	1.27	1.46
August	5,297	2,028	3,070	1.63	1.88
September	2,522	1,944	2,303	1.22	1.36
October	2,510	355	1,473	.784	.904
November	470	343	432	.230	.257
December	457	140	409	.218	.251
The year	9,435	140	2,262	1.20	16.35

PENOBSCOT RIVER AT WEST ENFIELD, ME.

This station was established by N. C. Grover, November 5, 1901, and prior to 1904 was designated as being at Montague, Me. In 1904 the name of this village was changed to West Enfield. The gaging station is located at the steel highway bridge, about 1,000 feet below the mouth of Piscataquis River.

The channel is straight for 1,000 feet above and 3,000 feet below the station, about 870 feet wide, and broken by four piers. The banks are high and rocky, and the bed permanent and rocky, with some gravel. The velocity is good at all stages. Water power is used on both Penobscot and Piscataquis rivers within a mile above the station. Fluctuations at the gage of 0.2 or 0.3 foot during low water are caused by changes in gate openings at the mills above.

Discharge measurements are made from the bridge. The initial point for soundings is on the easterly abutment, at the extreme end of the inclined post on the downstream side of the bridge.

A standard chain gage, which is read twice each day by A. H. Hanson, is fastened to the steel webbing on the upstream side of the bridge. The length of the chain was 34.49 feet when the gage was established, but changed to 34.44 feet June 24, 1905, owing to settling.

The gage is referred to bench marks as follows: (1) Top of northwest corner of first course below bridge seat, easterly abutment; elevation, 25.78 feet. (2) Copper bolt in outcropping ledge under bridge, near east abutment; elevation, 6.71 feet. (3) Marked point on bottom chord of bridge, under the gage; elevation, 29.52 feet. All elevations are above gage datum, which is at an elevation of 125.38 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 15; 82, p 16; 97, p 28; 124, pp 37-38.
Discharge: 65, p 15; 82, p 17; 97, p 28; 124, p 38.
Discharge, monthly: 82, p 18; 97, pp 31-32; 124, p 40.
Gage heights: 65, p 15; 82, p 17; 97, pp 29-30; 124, p 39.
Rating tables: 82, p 18; 97, p 31; 124, p 40.

Discharge measurements of Penobscot River at West Enfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 17	University of Maine students, under direction of Prof. H. S. Boardman.	886	8,200	3.32	9.00	27,200
May 1	do	869	5,900	2.69	6.40	15,900
September 29	do	690	2,730	1.48	2.70	4,050
September 30	do	690	2,730	1.48	2.65	4,060
October 3	do	675	2,410	1.64	2.40	3,960
October 5	do	643	2,350	1.44	2.12	3,390
October 18	do	620	2,173	1.27	1.90	2,770
October 19	do	620	2,047	1.39	1.90	2,840
October 24	do	579	1,728	1.10	1.30	1,900
October 25	do	577	1,670	1.12	1.25	1,870

Daily gage height, in feet, of Penobscot River at West Enfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				12.1	6.65	6.15	2.6	3.8	3.05	2.3	1.3	3.1
2	5.35			12.45	6.7	5.85	2.85	3.65	2.95	2.4	1.45	2.25
3				11.85	6.6	5.45	3.55	3.5	3.05	2.4	1.85	1.9
4				10.55	6.65	5.1	3.75	3.45	3.0	2.35	2.0	2.4
5				10.05	6.6	4.9	4.0	3.65	3.05	2.15	1.8	2.9
6		4.95	4.85	10.0	6.4	4.65	3.6	3.7	3.05	2.15	1.9	2.85
7				10.7	6.2	4.9	3.25	3.1	2.8	1.95	1.95	2.8
8				11.45	6.1	4.7	2.95	3.15	2.55	2.1	1.8	2.7
9	5.75			10.8	6.3	4.35	2.75	3.3	2.4	2.0	1.95	2.7
10				10.15	6.3	4.1	2.95	3.7	2.35	1.9	1.8	2.95
11				9.75	6.2	4.0	3.2	3.45	2.3	2.0	1.7	.....
12				9.8	6.1	4.3	3.7	2.75	2.2	2.0	1.35	.....
13		4.85	4.55	9.75	6.45	4.5	3.2	2.55	2.45	2.1	1.65	.....
14				9.45	6.2	4.65	3.1	2.8	2.1	2.1	1.7	.....
15				9.25	6.05	4.65	2.95	2.65	2.25	2.2	1.35	.....
16	5.65			9.1	6.35	4.6	2.65	2.55	2.2	2.15	1.3	.....
17				8.9	6.4	4.6	3.35	2.95	2.15	2.0	1.9	.....
18				8.55	6.8	4.25	3.45	3.2	2.35	1.9	2.0	.....
19				8.0	7.4	3.95	3.2	3.2	2.5	1.9	2.1	.....
20		4.75	4.28	7.65	8.05	4.0	3.1	3.05	2.6	1.9	2.25	.....
21			4.35	7.6	7.85	3.85	3.0	3.1	2.6	1.65	2.05	.....
22			4.5	7.95	7.55	3.75	2.9	2.65	2.6	1.3	1.9	.....
23	5.65		4.45	8.1	7.35	3.65	2.9	2.45	2.45	1.6	1.8	.....
24	5.65		4.6	8.1	7.05	3.4	3.2	2.25	2.35	1.3	1.8	.....
25	5.55		4.75	7.85	7.1	3.25	3.15	2.05	2.65	1.25	1.5	.....
26	5.65		5.35	7.65	7.1	3.15	3.35	2.05	2.5	1.2	1.15	2.4
27	5.55	5.15	5.75	7.35	7.05	3.35	3.2	2.45	2.5	1.3	1.7	.....
28			6.35	7.4	6.9	3.35	3.15	2.65	2.6	1.3	2.15	.....
29			7.5	7.1	6.7	3.05	3.25	2.7	2.65	1.0	1.8	.....
30	5.45		8.8	6.85	6.45	2.95	3.3	2.55	2.55	1.2	2.0	.....
31			10.65	.....	6.1	.....	3.45	2.8	.....	1.3	.....	.....

NOTE.—River was frozen January 1-21, open January 22-25, frozen January 26 to March 19, and open at the gage March 20 to April 10. The ice broke up at the bridge March 31. Jam of ice below the gage April 1-10. River clear of ice April 11. River frozen December 1-31, but open at the gage until December 11. During frozen periods gage heights are to the surface of the water in a hole cut in the ice.

The following thicknesses of ice were measured:

	Foot.		Foot.
January 2	0.8	February 20	0.8
January 9	.75	February 27	.7
January 16	.6	March 6	.4
January 27	.3	March 13	.3
January 30	.5	December 26 (gage height to top of ice 2.6 feet)	.8
February 6	.7		
February 13	.75		

Station rating table for Penobscot River at West Enfield, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	1,630	2.70	4,130	4.40	8,580	7.20	18,440
1.10	1,735	2.80	4,340	4.50	8,880	7.40	19,350
1.20	1,845	2.90	4,560	4.60	9,180	7.60	20,290
1.30	1,960	3.00	4,785	4.70	9,485	7.80	21,260
1.40	2,080	3.10	5,020	4.80	9,790	8.00	22,270
1.50	2,205	3.20	5,260	4.90	10,100	8.20	23,320
1.60	2,330	3.30	5,510	5.00	10,410	8.40	24,410
1.70	2,465	3.40	5,770	5.20	11,040	8.60	25,540
1.80	2,600	3.50	6,035	5.40	11,680	8.80	26,710
1.90	2,740	3.60	6,300	5.60	12,335	9.00	27,900
2.00	2,885	3.70	6,570	5.80	13,000	9.50	31,080
2.10	3,040	3.80	6,845	6.00	13,685	10.00	34,330
2.20	3,200	3.90	7,125	6.20	14,395	10.50	37,780
2.30	3,370	4.00	7,405	6.40	15,135	11.00	41,370
2.40	3,550	4.10	7,695	6.60	15,915	11.50	45,070
2.50	3,735	4.20	7,990	6.80	16,730	12.00	48,840
2.60	3,930	4.30	8,285	7.00	17,570	12.50	52,680

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1904–5. It is well defined between gage heights 1.2 feet and 12 feet.

Estimated monthly discharge of Penobscot River at West Enfield, Me., for 1905.

[Drainage area, 6,630 square miles.[a]]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April (11–30)	32,990	16,940	24,280	3.66	2.72
May	22,530	13,860	16,430	2.48	2.86
June	14,215	4,672	8,226	1.24	1.38
July	7,405	3,930	5,281	.797	.919
August	6,845	2,962	4,794	.723	.834
September	4,902	3,040	3,883	.586	.654
October	3,550	1,630	2,667	.402	.464
November	3,285	1,790	2,569	.387	.432

[a] Includes Chamberlain Lake drainage. See description of St. John River drainage basin, p. 20.

EAST BRANCH PENOBSCOT RIVER AT GRINDSTONE, ME.

This station was established October 23, 1902, by F. E. Pressey. It is located at the Bangor and Aroostook Railroad bridge, one-half mile south of the railroad station.

The channel is straight both above and below the station. The flow is moderately rapid at medium and high stages of the river, but sluggish at low water. Fluctuations in stage are usually slow, as no water power is used on the river above the station. Dams are maintained at the outlets of several of the lakes and ponds near the source of the river, and the impounded water is used for log driving. The bed is rocky and permanent; the stream is confined to the channel by the abutments of the bridge and has a width of about 275 feet, broken by one pier. Practically all land areas in this basin are in forest.

Discharge measurements are made from the railway bridge. The initial point for soundings is on the left bank at the lower end of the inclined end post.

A standard chain gage, which is read twice each day by Harry Stinson, is fastened to the guard timber on the upstream side of the bridge. The length of the chain was 31.99 feet when the gage was established, but changed to 31.95 feet July 5, 1905, owing to settling. The gage is referred to bench marks as follows: (1) Southwest corner of bridge seat on east abutment; elevation, 26.32 feet. (2) Copper bolt in ledge under north end of bridge; elevation, 8.78 feet. (3) Marked point on center stringer near gage; elevation, 29.78 feet. All elevations are above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 22; 97, pp 32-33; 124, pp 40-41.
Discharge: 82, p 22; 97, p 33; 124, p 41.
Discharge, monthly: 97, p 34; 124, p 43.
Gage heights: 82, p 22; 97, p 33; 124, p 42.
Rating table: 97, p 34; 124, p 43.

Discharge measurements of East Branch Penobscot River at Grindstone, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	F. E. Pressey	259	2,070	1.97	7.45	4,080
October 17	do	225	1,170	.10	3.96	122

Daily gage height, in feet, of East Branch Penobscot River at Grindstone, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					7.35	6.25	5.35	5.4	7.3	4.2	4.5	5.2
2				7.15	7.25	5.95	5.4	5.05	7.3	4.15	4.5	
3					7.1	6.05	5.55	4.9	7.3	4.1	4.5	
4			5.55		6.95	6.45	5.55	4.75	7.05	4.1	4.5	
5					6.4	7.15	5.55	4.7	6.25	4.1	4.4	
6		5.55			5.85	7.35	5.6	4.8	6.1	4.1	4.4	
7	5.65			8.95	5.95	7.05	5.35	4.9	5.85	4.1	4.4	
8				8.55	5.9	7.05	5.3	4.9	5.3	4.1	4.4	
9				8.4	5.85	7.05	5.35	4.9	5.15	4.4	4.4	4.4
10				7.85	5.85	7.15	5.4	4.65	4.8	4.3	4.4	
11			5.55	7.45	5.85	7.1	6.35	4.6	4.6	4.1	4.4	
12		5.55		7.45	5.85	7.05	6.15	4.5	4.4	4.1	4.5	
13				7.45	5.85	7.05	6.05	4.5	4.2	4.1	4.7	
14				7.2	6.1	7.05	6.0	4.5	4.2	4.1	4.7	
15				6.95	6.2	7.05	5.9	4.5	4.4	4.1	4.7	
16	5.65			6.95	6.35	7.05	5.9	4.5	4.4	4.1	4.7	4.4
17				6.7	6.5	6.8	5.9	4.5	4.5	4.2	4.7	
18		5.55	5.25	6.25	7.0	6.25	6.15	4.5	4.5	4.3	4.7	
19				6.15	7.4	5.35	6.7	4.5	4.5	4.3		
20				6.15	7.55	5.4	6.9	4.5	4.5	4.3		
21	5.55			6.85	7.5	5.15	6.9	4.5	4.5	4.3		
22				7.25	7.25	5.05	6.9	4.5	4.5	4.3		
23				7.75	7.25	5.05	6.85	4.4	4.3	4.3	4.9	
24				7.85	7.25	5.05	6.8	4.4	4.2	4.3		
25				7.9	7.45	5.1	7.0	4.4	4.2	4.05		
26		5.55	5.55	7.35	7.55	5.25	7.35	5.85	4.2	3.9		4.4
27				7.0	7.55	5.25	7.4	6.2	4.2	3.9		
28				7.05	7.25	5.3	7.4	6.35	4.2	3.9		
29				7.05	7.15	5.35	7.4	6.8	4.2	3.8		
30	5.6			7.15	6.6	5.35	7.4	6.9	4.2	3.8		4.4
31					6.35		7.4	7.1		3.8		

NOTE.—River frozen January 1 to April 7 and November 19 to December 31. During frozen period gage heights were read to the surface of the ice.

The following measurements of the thickness of the ice were made:

	Feet.
January 7	1.8
January 16	2.0
January 21	2.0
January 30	2.0
February 6	2.3
February 12	2.3
February 18	2.3
February 26	2.4
March 4	2.4
March 11	2.4
March 18	2.3
March 26	1.8
April 2	1.0
November 23	.2
December 1	.5
December 9	.5
December 16	.7
December 26	.7
December 30	.7

Station rating table for East Branch Penobscot River at Grindstone, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.80	140	4.90	570	6.00	1,580	7.20	3,495
3.90	160	5.00	630	6.10	1,705	7.40	3,880
4.00	185	5.10	700	6.20	1,840	7.60	4,285
4.10	210	5.20	775	6.30	1,980	7.80	4,710
4.20	240	5.30	855	6.40	2,130	8.00	5,155
4.30	275	5.40	940	6.50	2,285	8.20	5,620
4.40	315	5.50	1,030	6.60	2,445	8.40	6,110
4.50	360	5.60	1,130	6.70	2,610	8.60	6,630
4.60	405	5.70	1,235	6.80	2,780	8.80	7,190
4.70	455	5.80	1,345	6.90	2,955	9.00	7,780
4.80	510	5.90	1,460	7.00	3,130	9.20	8,380

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1902–1905, and is well defined.

Estimated monthly discharge of East Branch Penobscot River at Grindstone, Me., for 1905.

[Drainage area, 1,130 square miles.[a]]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 7–30	7,630	1,772	3,842	3.40	3.03
May	4,182	1,402	2,742	2.43	2.80
June	3,782	665	2,039	1.80	2.01
July	3,880	855	2,143	1.90	2.19
August	3,310	315	820	.726	.837
September	3,685	240	911	.806	.899
October	315	140	221	.196	.226
November 1–18	455	315	374	.331	.222

[a] Includes Chamberlain Lake drainage. See description of St. John River drainage basin, p. 20.

MATTAWAMKEAG RIVER AT MATTAWAMKEAG, ME.

This station was established August 26, 1902, by F. E. Pressey. It is located at the Maine Central Railroad bridge in the village of Mattawamkeag.

The channel is straight both above and below the station and has a width of about 400 feet at ordinary stages, broken by two piers. The bed of the stream is rocky and permanent. The water is confined to the channel by the abutments of the bridge. The current is strong at high and medium at low stages. Dams are maintained at the outlets of several of the lakes and ponds in this basin, and the stored water is used for driving logs. Probably 90 per cent of the land surface is in forest.

Discharge measurements at ordinary and high stages are made from the bridge, which is slightly oblique to the thread of the stream. The initial point for soundings is on the south abutment at the lower end of the inclined end post of the downstream truss. Low-water measurements are made by wading at a point about 1 mile above the station, where the velocities are greater than at the bridge and the bed is gravelly.

A standard chain gage, which is read twice each day by W. T. Mincher, is attached to the guard timber of the lower side of the bridge. The length of the chain is 33.40 feet. The gage is referred to bench marks as follows: (1) Southwest corner of bridge seat of north abutment; elevation, 26.87 feet. (2) Copper bolt in bowlder north of bridge and west of railroad; elevation, 19.01 feet. (3) Marked point on stringer near gage; elevation, 31.42 feet. All elevations are above gage datum, which is at elevation 185.93 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, pp 22-23; 97, p 35; 124, p 44.
Discharge: 82, p 23; 97, p 35; 124, p 45.
Discharge, daily: 97, p 37.
Discharge, monthly: 97, p 38; 124, p 47.
Gage heights: 82, p 23; 97, p 36; 124, pp 45-46.
Rating table: 97, p 36; 124, p 46.

Discharge measurements of Mattawamkeag River at Mattawamkeag, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 13	F. E. Pressey	404	2,460	4.37	9.40	10,740
May 5	do	396	1,350	3.07	6.69	4,150
June 23	Pressey and Adams	338	660	2.21	4.91	1,460
October 24	F. E. Pressey	153	120	.98	2.65	117
October 25 [a]	do	100	88	1.18	2.62	104
November 15 [a]	do	145	176	2.19	3.61	385

[a] Measurement made by wading about 1 mile above gage.

Daily gage height, in feet, of Mattawamkeag River, at Mattawamkeag, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	.....	.....	.....	6.9	5.3	4.2	3.5	2.8	2.7	2.6	4.9
2	.....	.....	.....	11.4	6.8	5.3	4.2	3.5	2.8	2.6	2.7	4.9
3	.....	.....	.....	8.85	6.7	5.3	4.2	3.5	2.8	2.6	2.7	4.7
4	.....	.....	.....	8.6	6.7	5.2	4.2	3.45	2.8	2.5	3.4	4.8
5	.....	4.7	4.9	8.45	6.65	5.2	4.2	3.3	2.9	2.5	3.5	4.9
6	.....	.....	.....	8.65	6.5	5.2	4.2	3.3	3.1	2.5	3.6	5.05
7	.....	.....	.....	9.2	6.3	5.2	4.2	3.3	3.1	2.5	3.6	5.0
8	.....	.....	.....	9.8	6.2	5.1	4.2	3.2	3.2	2.5	3.6	4.9
9	4.2	.....	.....	10.0	6.1	5.1	4.2	3.2	3.2	2.5	3.6	4.8
10	.....	.....	.....	10.0	6.1	4.95	4.2	3.25	3.2	2.5	3.6	4.65
11	.....	.....	.....	9.9	6.1	4.85	4.1	3.4	3.1	2.5	3.7	4.5
12	.....	4.7	4.7	9.6	6.15	4.7	4.1	3.4	3.0	2.5	3.7	4.4
13	.....	.....	.....	9.45	6.1	4.65	4.0	3.4	3.0	2.6	3.7	4.4
14	.....	.....	.....	9.3	5.95	4.8	4.0	3.25	3.2	2.6	3.7	4.55
15	.....	.....	.....	9.3	5.65	4.95	3.9	3.1	3.4	2.6	3.6	4.8
16	4.7	.....	.....	9.3	5.65	5.2	3.9	3.1	3.35	2.6	3.6	4.9
17	.....	.....	.....	9.15	5.9	5.55	3.8	3.0	3.3	2.5	3.7	4.9
18	.....	.....	.....	8.8	6.1	5.25	3.7	3.2	3.2	2.5	3.95	4.85
19	.....	.....	4.7	8.4	6.5	5.35	3.7	3.2	3.2	2.6	4.25	4.75
20	.....	4.4	.....	8.15	6.75	5.7	3.7	3.2	3.3	2.6	4.6	4.8
21	.....	.....	.....	7.9	7.35	5.6	3.7	3.15	3.2	2.7	4.3	4.8
22	4.7	.....	.....	7.9	7.2	5.1	3.7	3.0	3.2	2.7	4.05	4.7
23	.....	.....	.....	8.0	7.2	4.95	3.7	2.9	3.1	2.7	3.9	4.7
24	.....	.....	.....	8.0	7.3	4.75	3.55	2.85	2.0	2.7	3.9	4.6
25	.....	.....	.....	8.0	7.15	4.55	3.4	3.0	2.95	2.7	4.0	4.6
26	.....	4.7	4.9	7.9	6.8	4.4	3.6	3.1	2.8	2.7	4.0	4.5
27	.....	.....	.....	7.7	6.45	4.3	3.7	3.0	2.8	2.7	4.0	4.5
28	.....	.....	.....	7.35	6.0	4.4	3.6	2.9	2.7	2.6	4.0	4.4
29	4.7	.....	.....	7.1	5.6	4.3	3.45	2.9	2.7	2.6	4.15	4.4
30	.....	.....	.....	7.0	5.45	4.3	3.5	2.7	2.7	2.6	4.4	4.5
31	.....	.....	.....	.....	5.3	.....	3.5	2.8	.....	2.6	.....	4.5

NOTE.—River frozen January 1 to April 1, and December 17–31. For these periods the gage-height readings were taken to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	4.0	.....	0.7
January 9	4.2	.....	1.0
January 16	4.7	.....	1.2
January 22	4.7	.....	1.3
January 29	4.7	5.0	1.3
February 5	4.7	4.9	1.6
February 12	4.7	4.9	1.6
February 20	4.4	4.6	1.6
February 26	4.7	4.9	1.6
March 5	4.9	5.0	1.6
March 12	4.7	4.9	1.6
March 19	4.7	4.9	1.6
March 26	4.9	5.1	1.6

April 6, river clear of ice. May 8–9 and November 3, no record; gage heights estimated. December 17–31, river frozen over, but not safe to go upon; ice 0.6 foot thick December 31.

Station rating table for Mattawamkeag River at Mattawamkeag, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	86	4.00	660	5.50	2,359	8.00	7,275
2.60	100	4.10	736	5.60	2,505	8.20	7,750
2.70	114	4.20	818	5.70	2,658	8.40	8,235
2.80	134	4.30	906	5.80	2,818	8.60	8,730
2.90	160	4.40	1,000	5.90	2,985	8.80	9,235
3.00	190	4.50	1,100	6.00	3,160	9.00	9,750
3.10	223	4.60	1,206	6.20	3,525	9.20	10,275
3.20	258	4.70	1,318	6.40	3,900	9.40	10,820
3.30	295	4.80	1,436	6.60	4,285	9.60	10,380
3.40	334	4.90	1,559	6.80	4,675	9.80	11,945
3.50	375	5.00	1,687	7.00	5,075	10.00	12,520
3.60	420	5.10	1,817	7.20	5,495	10.50	14,000
3.70	470	5.20	1,949	7.40	5,920	11.00	15,590
3.80	525	5.30	2,083	7.60	6,360		
3.90	590	5.40	2,219	7.80	6,810		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1902–1905. It is well defined between gage heights 2.6 feet and 9.5 feet.

Estimated monthly discharge of Mattawamkeag River at Mattawamkeag, Me., for 1905.

[Drainage area, 1,510 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 2-30	16,910	5,075	9,194	6.09	6.57
May	5,812	2,083	3,498	2.58	2.97
June	2,658	906	1,695	1.12	1.25
July	818	334	601	.398	.459
August	375	114	250	.166	.191
September	334	114	209	.138	.154
October	114	86	98.7	.065	.075
November	1,206	100	541	.358	.399
December 1-16	1,752	1,000	1,461	.967	.595

PISCATAQUIS RIVER NEAR FOXCROFT, ME.

This station was established August 17, 1902, by F. E. Pressey. It is located at Low's bridge, about half way between Guilford and Foxcroft.

The channel is straight above and below the station, and has a width at ordinary stages of about 90 feet. The banks are high and rocky; the bed is rough and rocky, but permanent. The current is strong at high and medium at low stages. Water power is used at several manufacturing plants within a few miles above the station. As a result of the interruptions due to the irregular use of water at the mills, the river fluctuates, at low stages, through nearly a foot on the gage within the day. The small amount of stored water in this basin is generally used for log driving. Slopes are steep. The river rises and falls rapidly. Probably 50 per cent of the basin is in forest.

Discharge measurements are made at ordinary and high stages from the bridge. The initial point for soundings is on the left bank at the top of the face of the left abutment. Low-water measurements are made by wading, either above or below the bridge, at points where the bed is fine gravel, and the velocity is greater than at the bridge.

A staff gage is spiked vertically to the left abutment. It is read twice each day by A. F. D. Harlow. The gage is referred to bench marks as follows: (1) Top of second course from top of left abutment; elevation, 17.80 feet. (2) Copper bolt in ledge 150 feet north of highway and 75 feet west of river; elevation, 20.97 feet. (3) Marked point on bottom chord of upstream truss of bridge, 30 feet from the initial point; elevation, 21.80 feet. All elevations are above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 23; 97, pp 38-39; 124, pp 47-48.
Discharge: 82, p 23; 97, p 39; 124, p 48.
Discharge, monthly: 82, p 24; 97, p 41; 124, p 50.
Gage heights: 82, p 24; 97, p 40; 124, pp 48-49.
Rating tables: 82, p 24; 97, p 40; 124, p 49.

Discharge measurements of Piscataquis River near Foxcroft, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 15	F. E. Pressey	128	550	5.24	5.35	2,880
June 20	Pressey and Adams	104	230	1.85	3.04	425

Daily gage height, in feet, of Piscataquis River near Foxcroft, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	3.1	3.8	8.3	3.5	2.9	2.4	2.4	2.1	2.0	2.0	2.1
2	3.5	3.1	3.8	6.5	3.8	2.8	2.8	2.4	2.3	2.2	2.0	2.2
3	3.5	3.2	3.8	6.5	4.0	2.8	3.7	2.4	1.8	2.3	2.0	2.2
4	3.2	3.7	3.8	4.8	4.5	2.8	3.3	2.4	2.2	2.3	2.0	2.4
5	3.2	2.8	3.6	4.3	4.4	2.6	3.0	2.4	2.3	2.3	1.7	2.4
6	3.1	3.2	3.5	5.2	4.4	3.0	2.8	.8	2.6	2.2	2.0	2.4
7	3.0	3.7	3.0	8.2	4.2	3.0	2.8	2.0	2.6	2.0	2.0	2.4
8	3.0	3.7	2.6	5.7	4.0	2.8	2.8	2.1	2.7	1.8	2.0	2.4
9	3.4	3.2	2.6	4.7	3.9	2.8	2.6	2.1	2.2	2.3	2.3	2.2
10	4.0	3.2	2.5	4.7	3.9	2.7	2.6	2.2	2.0	2.3	2.2	2.0
11	4.0	3.2	2.4	4.7	3.1	2.4	2.6	2.2	2.3	2.3	2.0	2.2
12	4.0	3.2	2.4	4.9	3.1	2.6	2.6	2.2	2.4	2.3	1.7	2.5
13	4.0	3.2	2.5	5.0	3.3	3.1	2.5	1.5	2.4	2.3	2.0	2.6
14	4.0	3.2	2.5	4.8	3.7	3.1	2.5	2.3	2.4	2.3	2.2	2.6
15	3.6	3.3	2.6	5.2	4.1	3.0	2.0	2.3	2.4	1.7	2.0	2.6
16	4.0	3.4	2.6	5.0	3.3	3.0	2.0	2.3	2.3	2.2	1.9	2.6
17	3.6	3.3	2.6	4.6	3.3	2.8	2.2	2.2	2.0	2.2	2.2	2.2
18	3.7	3.2	2.6	4.3	3.3	2.9	2.0	2.2	2.0	2.2	2.4	2.1
19	3.8	2.8	2.4	4.4	3.3	3.3	2.0	2.2	1.7	2.0	2.6	2.2
20	3.7	3.0	2.8	3.6	3.8	3.5	2.1	2.2	1.7	1.9	2.2	2.0
21	3.4	3.0	3.0	3.9	3.8	3.4	2.1	2.2	1.8	1.9	2.2	2.0
22	3.4	3.1	3.0	4.6	3.4	3.2	2.0	2.2	2.2	1.6	2.2	2.0
23	3.6	3.2	3.1	4.7	3.2	3.1	2.0	2.2	2.2	1.9	2.1	2.0
24	3.6	3.3	3.2	4.3	3.2	2.9	2.2	2.2	1.9	1.9	2.0	2.0
25	3.6	3.4	3.2	4.2	3.2	3.0	2.2	2.2	2.0	1.9	1.9	2.0
26	3.4	4.2	3.2	4.3	3.1	2.8	2.2	2.2	2.0	1.9	1.8	2.0
27	3.6	4.2	4.8	4.4	3.3	2.9	2.2	1.8	2.2	1.9	2.3	2.0
28	3.4	4.0	5.4	4.4	3.3	2.9	2.2	2.0	2.2	1.9	2.2	2.0
29	2.8	.....	6.5	3.8	2.9	2.8	2.2	2.0	1.9	1.5	2.2	1.9
30	3.2	.....	6.6	3.5	2.9	2.5	2.2	2.1	1.9	1.5	2.0	1.9
31	3.2	.....	8.0	.....	2.9	.....	2.5	2.1	.....	1.5	.....	1.9

NOTE.—Ice in river broke up March 30; river clear of ice April 7. River did not freeze at section near gage during 1905.

Station rating table for Piscataquis River near Foxcroft, Me., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	19	2.70	267	3.90	1,113	5.20	2,635
1.60	24	2.80	318	4.00	1,208	5.40	2,940
1.70	31	2.90	374	4.10	1,303	5.60	3,265
1.80	40	3.00	437	4.20	1,403	5.80	3,610
1.90	51	3.10	502	4.30	1,508	6.00	3,970
2.00	64	3.20	569	4.40	1,615	6.20	4,335
2.10	81	3.30	638	4.50	1,725	6.40	4,705
2.20	100	3.40	709	4.60	1,840	6.60	5,080
2.30	123	3.50	782	4.70	1,960	6.80	5,460
2.40	148	3.60	858	4.80	2,085	7.00	5,840
2.50	180	3.70	938	4.90	2,215		
2.60	220	3.80	1,023	5.00	2,350		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1902-1905. It is well defined between gage heights 1.5 feet and 6 feet.

Estimated monthly discharge of Piscataquis River near Foxcroft, Me., for 1905.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January [a]	1,208	64	788	2.81	3.24
February [a]	1,403	318	674	2.41	2.51
March [a]	7,810	148	1,119	4.00	4.61
April [a]	8,425	782	2,460	8.79	9.81
May	1,725	374	858	3.06	3.53
June	782	148	395	1.41	1.57
July	938	64	200	.714	.823
August [b]	148	5	96.4	.344	.397
September	267	31	103	.368	.411
October	123	19	76.1	.272	.314
November	220	31	82.2	.294	.328
December	220	51	108	.385	.444
The year	8,425	5	580	2.07	27.99

[a] Estimates January 1 to April 7 may have been affected by ice conditions on the river. The river was open at the gage.
[b] August 6, discharge estimated at 5 second-feet. The water was held back on account of construction work on the river.

COLD STREAM AT ENFIELD, ME.

Cold Stream is the outlet from Cold Stream Pond—really a series of ponds comprising a total area of water surface of about 10 square miles, the largest, which is mostly in the town of Enfield, having an area of about 8 square miles.

Cold Stream flows into Passadumkeag Stream, a tributary of the Penobscot, at a distance of some 4½ miles from Cold Stream Pond, and has a total drainage area of about 37 square miles. The basin is mostly wooded and but sparsely settled. During the first half mile the fall is rapid, but through the rest of its course the stream runs through a great swamp and is tortuous, with a sluggish current. Near the village of Enfield a fall of perhaps 10 to 12 feet has in the past been developed for power for a saw and shingle mill, but is not now in use. This drainage basin has been considered as a source of water supply for the district, which includes Bangor and some other adjacent towns.

This station was established June 14, 1904, by N. C. Grover, and was located at the highway bridge about three-fourths of a mile south of Enfield, on the road to Passadumkeag. During the summer it was found that the gage was within the influence of backwater from Passadumkeag Stream, and consequently, on September 12, 1904, the gage was taken from the highway bridge mentioned above and placed about 200 feet below the old mill, near the Enfield post-office. The drainage area at this point is about 26 square miles.

The stream is fairly straight in the vicinity of the measuring section and is about 30 feet wide at ordinary stages. The depth is usually about 0.9 foot and the velocity is high at all stages. The bed of the stream is rocky and permanent; the banks are not high and probably overflow at high stages.

Discharge measurements are made at low and medium stages by wading in the vicinity of the gage. High-water measurements are made from the bridge about 600 feet above the gage.

A standard chain gage which is read once each day by A. J. Twombley, is fastened to a clump of maple trees on the right bank of the river. The length of the chain is 10.24 feet. The gage is referred to bench marks as follows: (1) Spike in maple

tree near the gage; elevation, 6.89 feet. (2) Point on a rock marked "B. M.-2," about 8 feet downstream from the gage, on the right bank; elevation, 4.55 feet. (3) Center of the gage-box pulley; elevation, 9.03 feet. Elevations are above gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pages 50-51.

Discharge measurements of Cold Stream at Enfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28	F. E. Pressey	33	19.7	1.15	2.68	22.6
May 3	do	41	44	3.81	3.33	168
May 8	do	33	19.3	1.52	2.63	29.3
May 26	do	32	23	2.23	2.78	52
May 26	do	28	18.2	3.03	2.78	55
May 26	do	16.5	22	1.87	2.78	42
June 24	do	32	23	2.30	2.80	52
October 23	do	30	14.1	1.51	2.68	21.3
November 28	do	34	12.4	1.28	2.64	15.9

Daily gage height, in feet, of Cold Stream at Enfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.7	2.8	2.9	3.9	2.8	2.7	2.7	2.5	2.7	2.6	2.7
2	2.6	2.8	2.7	2.8	3.6	2.7	2.7	2.6	2.5	2.7	2.6	2.6
3	2.7	2.7	2.8	2.8	3.4	2.7	2.8	2.6	2.6	2.7	2.7	2.6
4	2.7	2.7	2.6	2.9	3.4	2.8	2.8	2.5	2.6	2.6	2.7	2.6
5	2.6	2.7	2.6	2.9	3.1	2.8	2.8	2.5	2.7	2.6	2.7	2.6
6	2.6	2.7	2.6	3.0	2.9	2.8	2.8	2.5	2.6	2.7	2.7	2.6
7	2.6	2.7	2.8	3.0	2.7	2.8	2.7	2.5	2.6	2.7	2.7	2.7
8	2.8	2.7	2.8	2.8	2.6	2.8	2.7	2.5	2.8	2.6	2.6	2.7
9	2.8	2.7	2.7	2.7	2.6	2.8	2.8	2.5	2.8	2.6	2.6	2.7
10	2.7	2.7	2.7	2.7	3.0	2.8	2.8	2.5	2.8	2.6	2.6	2.6
11	2.7	2.7	2.8	2.7	3.2	2.8	2.8	2.5	2.8	2.6	2.7	2.9
12	2.7	2.7	2.8	2.7	3.2	2.7	2.8	2.4	2.8	2.7	2.7	2.8
13	2.7	2.7	2.7	2.7	3.1	2.8	2.8	2.4	2.8	2.7	2.6	2.6
14	2.6	2.7	2.7	2.6	3.1	2.7	2.9	2.4	2.8	2.7	2.6	2.6
15	2.6	2.8	2.7	2.7	3.0	2.8	2.9	2.4	2.7	2.7	2.7	2.6
16	2.6	2.7	2.7	2.7	3.0	2.8	2.8	2.5	2.7	2.7	2.7	2.6
17	2.8	2.7	2.6	2.7	2.7	2.7	2.7	2.5	2.7	2.6	2.7	2.6
18	2.8	2.7	2.6	2.6	2.7	2.7	2.8	2.5	2.7	2.6	2.7	2.6
19	2.7	2.7	2.7	2.6	2.6	2.8	2.8	2.5	2.8	2.6	2.6	2.6
20	2.8	2.7	2.7	2.7	2.7	2.8	2.8	2.5	2.8	2.6	2.6	2.6
21	2.9	2.7	2.7	2.6	2.7	2.8	2.8	2.5	2.8	2.7	2.6	2.7
22	2.8	2.7	2.8	2.6	2.7	2.9	2.9	2.5	2.7	2.6	2.6	2.7
23	2.7	2.7	2.8	2.7	2.7	2.9	2.8	2.5	2.7	2.6	2.6	2.6
24	2.7	2.7	2.7	2.6	2.8	2.9	2.8	2.5	2.7	2.6	2.6	2.6
25	2.7	2.7	2.7	2.6	2.8	2.8	2.9	2.5	2.7	2.7	2.6	2.6
26	2.6	2.7	2.8	2.6	2.7	2.8	2.8	2.5	2.7	2.7	2.6	2.6
27	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.6	2.8	2.6	2.6	2.6
28	2.7	2.6	2.6	2.8	2.8	2.8	2.9	2.5	2.8	2.7	2.7	2.6
29	2.7	.....	2.7	3.6	2.8	2.8	2.8	2.5	2.8	2.7	2.7	2.6
30	2.6	.....	2.8	3.7	2.8	2.8	2.7	2.5	2.8	2.7	2.7	2.6
31	2.6	.....	2.8	.....	2.8	.....	2.6	2.5	.....	2.7	.....	2.6

NOTE.—River was frozen December 11-13; ice reached a thickness of 0.3 foot.

PHILLIPS LAKE AND OUTLETS IN HOLDEN AND DEDHAM, ME.

Phillips Lake drains an area of about 11.5 square miles and has a water surface of about 1.4 square miles. It is situated about 10 miles southeast of the city of Bangor. The shores are generally rocky, and the adjacent country mostly wooded and but sparsely settled. The water is apparently of excellent quality and of considerable depth. This lake is under consideration as a new source of water supply for the city of Bangor. It has two drainage outlets. The greater amount of water flows from the north end of the lake northward through the village of East Holden, thence southward through Long Pond and into Penobscot River below Bucksport. The total length of this outlet is 18 miles. The other outlet, situated at the southeast end of the lake, in the town of Dedham, flows into Green Lake and thence into Union River. Through this outlet there is flow only during medium and high stages.

The United States Geological Survey maintains gages at the two outlets of the lake, also a gage for obtaining a record of lake level.

The station at the northern outlet was established July 7, 1904, by F. E. Pressey. It is located about 1¼ miles from the lake, one-fourth mile south of the village of East Holden, and 175 feet south of an old mill. The drainage area at this point is 12.3 square miles. A plain staff gage was first used, attached vertically to a maple tree on the right bank, but this was replaced on December 6, 1904, by a standard chain gage attached to the same maple tree; length of chain, 9.48 feet. The gage is referred to bench marks as follows: (1) A spike, approximately vertical, in the foot of the tree to which the gage is attached, inclosed in a circle and marked "B. M.-1;" elevation, 5.24 feet above gage datum. (2) The highest point on a large stone about 25 feet upstream from the gage in the bed of the stream. It is inclosed in a circle and marked "B. M.-2;" elevation, 5.51 feet above gage datum. (3) Spike driven into maple tree to which gage is attached, approximately horizontal, for use in measuring to the water surface; elevation, 6.17 feet above gage datum. (4) Center of gage-box pulley; elevation, 8.30 feet above gage datum.

Discharge measurements are made at ordinary stages by wading near the gage. At high water they can be made from a railroad bridge about 1 mile upstream. The channel is straight for about 10 to 12 feet above the gage and curved just below the gage. The bed is rocky and rough, but permanent. The banks are high and not subject to overflow. There is but one channel at all stages. The ordinary width is about 10 feet; depth, 0.8 foot; velocity, high at all stages. The gage is read once each day by Lewis Pinkham, of East Holden.

The station at the southeastern outlet was established July 19, 1904, by H. K. Barrows. It is located at the highway bridge about 1½ miles southeast of Lake House railroad station, and is about 700 feet southeast of the Maine Central Railroad crossing. A plain staff gage is fastened vertically to the logs of the floor and the right abutment of the single-span highway bridge. It is referred to bench marks as follows: (1) A point and circle on stone of the southeast abutment of the bridge marked "B. M.—1;" elevation, 6.31 feet above gage datum. (2) Highest point of stone about 50 feet north of the gage on the west side of the road, inclosed by a circle and marked "B. M.—2;" elevation, 10.04 feet above gage datum.

Discharge measurements are made at low and medium stages by wading just below the bridge, and at high stages from the downstream side of the bridge to which the gage is attached. The channel is curved for about 25 feet above the station and straight for some 30 feet below. The bed of the stream is of gravel, rough but permanent. The banks are rocky, wooded, and liable to overflow. There is but one channel at all stages. The gage is read only when meter measurements are made, as the flow through this outlet is closely proportional to the lake height.

The station on Phillips Lake was established July 19, 1904, by H. K. Barrows. It is located about one-fourth mile west of Lake House railroad station. The gage is a

plain vertical staff, fastened to a bowlder on the east shore of the lake about 300 feet northwest of Dr. L. S. Chilcott's cottage. It is referred to bench marks as follows: (1) A point on ledge of rock east of the gage, inclosed by a circle and marked "B. M.—1;" elevation, 10.28 feet above gage datum. (2) A point on a ledge of rock about 10 feet west of the gage, inclosed by a circle and marked "B. M.—2;" elevation, 11.86 feet above gage datum. This gage is not now in use, as an additional vertical staff gage, referred to the same datum, was established on December 6, 1904. It is fastened to the east abutment of the Maine Central Railroad bridge over the north end of Phillips Lake. It is referred to bench marks as follows: (1) The northwest corner of wing wall at west end of bridge; elevation, 16.79 feet above gage datum. This gage is read once a week by H. C. Lord.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 52–54.

Discharge measurements of Phillips Lake, northern outlet, at East Holden, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 17	F. E. Pressey	15.5	9.9	2.44	1.84	24.2
May 25 [a]	do	17.0	11.1	2.45	1.90	27.2
April 29 [a]	do	17.0	12.2	2.52	1.90	30.7
June 17	Pressey and Adams	12.5	11.5	1.87	1.82	21.5
August 11	F. E. Pressey	12.5	9.2	1.63	1.77	15.0
August 15	Barrows and Pressey	9.3	8.6	1.28	1.67	11.0
September 2	F. E. Pressey	9.5	9.3	1.35	1.74	12.6
October 21	do	5.7	3.0	.60	1.41	1.8

[a] From log across stream 100 feet below gage.

Discharge measurements of Phillips Lake, southeastern outlet, near Lake House railroad station, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Gage height, Phillips Lake.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet*	*Feet.*	*Sec.-ft.*
April 17	F. E. Pressey	8.0	19.3	2.26	2.80	9.40	42.7
April 29	do	8.0	15.4	.79	2.28	8.94	12.2
May 25	do	8.0	14.3	.83	2.20	8.97	11.9
June 17	Pressey and Adams	4.0	1.8	1.83	1.62	8.48	3.3
August 11	F. E. Pressey	2.5	1.19	1.05	1.38	7.37	1.25
August 15	Barrows and Pressey	2.5	1.06	.98	1.35	7.20	1.04
September 2	F. E. Pressey	.5	.08	.67	1.06	6.40	.05
October 21	do	.35	.05	.58	1.10	6.00	.03

Daily gage height, in feet, of Phillips Lake, northern outlet, at East Holden, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.75	1.6	2.05	1.9	1.9	1.85	1.55	1.8	1.4	1.7	1.5
2	1.6	1.75	1.6	1.8	1.9	1.9	1.9	1.55	1.8	1.4	1.5	1.5
3	1.6	1.75	1.6	1.8	1.85	1.9	1.9	1.55	1.8	1.4	1.5	1.7
4	1.6	1.75	1.6	1.85	1.95	1.9	1.9	1.55	1.8	1.4	1.5	1.7
5	1.7	1.75	1.6	1.9	1.9	1.9	1.7	1.55	1.8	1.4	1.5	1.55
6	1.7	1.7	1.6	2.2	1.95	2.0	1.7	1.55	1.6	1.4	1.5	1.55
7	1.7	1.7	1.6	2.2	1.9	1.9	1.5	1.8	1.5	1.4	1.5	1.55
8	2.7	1.7	1.55	2.1	1.9	1.9	1.5	1.85	1.45	1.4	1.55	1.55
9	2.55	1.7	1.55	2.0	1.9	1.9	1.5	1.8	1.4	1.4	1.6	1.6
10	2.15	1.7	1.55	1.9	1.9	1.9	1.5	1.8	1.4	1.4	1.55	1.75
11	2.05	1.7	1.5	1.9	1.9	1.9	1.5	1.8	1.4	1.4	1.5	1.9
12	1.95	1.7	1.5	1.9	1.95	1.85	1.5	1.8	1.4	1.4	1.5	1.7
13	1.95	1.7	1.5	1.8	1.95	1.9	1.55	1.8	1.4	1.4	1.5	1.6
14	1.9	1.7	1.5	1.8	1.95	1.85	1.55	1.8	1.4	1.4	1.5	1.6
15	1.9	1.7	1.5	1.8	1.95	1.85	1.55	1.8	1.4	1.8	1.5	1.6
16	1.9	1.7	1.5	1.85	2.0	1.85	1.55	1.75	1.4	1.5	1.6	1.6
17	1.85	1.65	1.5	1.85	2.05	1.85	1.55	1.7	1.4	1.4	1.6	1.6
18	1.85	1.65	1.5	1.8	2.0	1.85	1.55	1.7	1.4	1.4	1.55	1.6
19	1.85	1.65	1.55	1.9	2.0	1.9	1.55	1.7	1.4	1.4	1.5	1.9
20	1.8	1.65	1.6	1.9	2.0	1.95	1.55	1.7	1.4	1.4	1.5	1.9
21	1.8	1.65	1.55	1.85	2.0	1.95	1.55	.....	1.4	1.4	1.5	1.9
22	1.8	1.6	1.6	2.0	2.0	1.95	1.55	.....	1.4	1.8	1.5	2.3
23	1.8	1.6	1.6	2.0	2.0	1.9	1.55	1.9	1.4	1.5	1.5	1.9
24	1.8	1.6	1.6	2.0	2.0	1.9	1.55	1.9	1.4	1.5	1.5	2.0
25	1.8	1.6	1.7	2.0	1.95	1.9	1.55	1.9	1.4	1.5	1.4	2.4
26	1.8	1.6	1.9	1.95	1.95	1.85	1.55	1.9	1.4	1.5	1.4	2.0
27	1.8	1.6	1.95	1.9	1.9	1.9	1.55	1.85	1.4	1.5	1.4	1.9
28	1.8	1.6	2.0	1.9	1.9	1.85	1.55	1.85	1.4	1.5	1.4	1.9
29	1.8	.....	2.1	1.9	1.9	1.85	1.55	1.85	1.4	1.5	1.45	1.9
30	1.8	.....	2.1	1.9	1.9	1.85	1.55	1.8	1.4	1.5	1.5	1.8
31	1.75	.....	2.3	.....	1.9	.....	1.6	1.8	.....	1.5	.....	1.8

NOTE.—River did not freeze near gage during 1905.

Daily gage height, in feet, of Phillips Lake near East Holden, Me., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			9.5			8.1					
2								6.4			6.5
3					8.7						
4	8.8	8.3								6.0	
5							7.6				
6				8.9							
7									6.3		
8			9.7			8.0					
9								6.4			7.4
10					8.6						
11	8.8	8.3								6.2	
12							7.4				
13				8.8							
14									6.2		
15			9.6			7.9	7.2				
16								6.4			7.6
17			9.4		8.5						
18	8.3	8.2								6.3	
19							7.1				
20				9.1							
21									6.1		
22			9.3			7.7					
23								6.4			7.6
24					8.2						
25	8.4	8.5		9.0						6.3	
26							6.7				
27				8.9							
28									6.0		
29			9.0			7.6					
30								6.3			7.6
31											

NOTE.—February 4, 11, gage height to top of ice; ice 4 inches thick. February 18, 25, and March 4, no ice at gage. April 22, ice left lake. December 16, 2 inches ice at gage. December 23, 30, no ice at gage.

KENNEBEC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kennebec River is one of the best streams in the United States for the development of water power. Its basin, which lies wholly within the State of Maine, between those of Androscoggin and the Penobscot, is 150 miles in length and from 50 to 80 miles in width in the main portion, embracing a total area of 6,110 square miles. Of this area, 1,330 square miles are tributary to Moosehead Lake, in which the river has its source. The upper tributaries, however, rise in the hilly, forested areas lying to the east and west of that lake. Of these, Moose River is the most important. The northern part of the drainage basin is broken by offsets from the White Mountains. Nearly the whole of the upper portion is forest covered and in its original wild state.

Below the outlet of Moosehead Lake the hills close in on the river, forming a narrow, rocky chasm, with steep and precipitous sides. From Moosehead Lake to The Forks the river is a torrent, the total fall in the 23 miles being 500 feet. Dead River is tributary to the Kennebec at The Forks. Below this junction the river flows with a lesser slope in a narrow, winding bed, about 20 miles to Bingham;

thence through a broader valley in which are located many farms. Between Bingham and tide water there are a number of large falls, at which water power has been developed.

The prevailing rock in the northern part of the basin is slate, with a belt of sandstone to the west and a district of granite to the east of Moosehead. South of Bingham mica-schists run into the clay slate in spots and elsewhere into gneiss, but (except where broken by intrusions of granite, as at Hallowell and Augusta) slate prevails as far as Gardiner. Below the latter city gneiss predominates, with stretches of mica-schists on the east bank. The surface materials are finely pulverized. Water retaining sands and gravels are more abundant in the northern part, succeeded by a greater proportion of loam and clay to the south.

Surveys have been made in the Kennebec River drainage basin by the United States Geological Survey as follows: 1903 and 1904, plan and profile of Kennebec River between tide water and Moosehead Lake; 1905, plan and profile of Moose River between Moosehead and Brassua lakes, and above Brassua to near Little Brassua Lake; survey for plan of Brassua Lake and Wood Pond, showing shore lines, contours on banks, soundings, etc.

The areas of the drainage basins of the river and its principal tributaries are given in the following table:

Drainage areas of Kennebec River and principal tributaries.

River.	Locality.	Drainage area.
		Sq. miles.
Kennebec	Outlet of Moosehead Lake	1,330
Do	The Forks at gaging station	1,670
Do	Immediately below mouth of Dead River	2,540
Do	Caratunk Falls, Solon	2,790
Do	North Anson, above mouth of Carrabassett River, at gaging station.	2,880
Do	Madison	3,310
Do	Norridgewock	4,020
Do	Fairfield	4,370
Do	Waterville, above mouth of Sebasticook River, at Hollingsworth & Whitney dam.	4,380
Do	Waterville, below mouth of Sebasticook River	5,310
Do	Augusta	5,710
Do	Head of Merrymeeting Bay	6,110
Moose	Mouth and at gaging station	680
Roach	Roach River	85
Do	Mouth	120
Dead	Mouth, The Forks, and at gaging station	870
Carrabassett	North Anson, above Embden Brook, at gaging station	340
Do	Mouth	395
Sandy	Farmington	350
Do	At gaging station	650
Do	Mouth	670
Sebasticook	do	930
Messalonskee	At gaging station	205
Do	Mouth	208
Cobbosseecontee	Mouth and at gaging station	240

KENNEBEC RIVER AT THE FORKS, ME.

This station was established September 28, 1901, by N. C. Grover, at the wooden highway bridge across Kennebec River at The Forks, above the mouth of Dead River. Of the drainage area at this station, 1,330 square miles are tributary to Moosehead Lake and the remaining 340 square miles drain into the Kennebec by small streams with steep slopes and no storage. Practically all land surfaces above this point are in forest.

The channel is straight for 200 feet above and 500 feet below the station, is unbroken by piers, and is about 125 feet wide at ordinary stages of the river. The current is swift at high and medium at low stages. The banks are high and rocky and the bed is rocky and permament.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank, marked by a rod across the bridge, just above the abutment and below the bridge floor.

There are two gages—one, a vertical rod, is attached to the timber retaining wall on the left bank, about 75 feet above the bridge; the other is a standard chain gage attached to the bridge floor. The length of the chain is 17.18 feet. Gage-height observations are made twice each day by William W. Young. The datum of the two gages is the same and is referred to two bench marks: (1) The top of a bolt on the east abutment, north side of bridge, elevation, 12.85 feet; (2) marked point on the floor of the bridge, near the east end of the gage box, elevation, 15.42 feet. Elevations are above gage datum, which is 562.85 feet above mean sea level, as determined by the Kennebec River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 16; 82, pp 26–27; 97, p 43; 124; pp 56–57.
Discharge: 65, p 16; 82, p 27; 97, p 43; 124, p 57.
Discharge, monthly: 82, p 28; 97, p 45; 124, p 59.
Gage heights: 65, p 16; 82, p 27; 97, p 44; 124, p 58.
Rating tables: 82, p 28; 97, p 45; 124, p 58.

Discharge measurements of Kennebec River at The Forks, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 21	F. E. Pressey	121	660	1.82	1.90	1,200
July 18	do	119	620	1.53	1.53	950
September 4	H. K. Barrows	123	730	2.19	2.30	1,600

Daily gage height, in feet, of Kennebec River at The Forks, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.8	5.1	.....	2.95	4.25	.....	.....	1.4	2.7	1.6	1.6	1.3
2	4.7	5.1	.....	2.85	2.55	.....	.....	3.3	2.7	1.6	1.6	1.3
3	4.8	5.2	4.5	2.6	2.35	.....	.....	2.9	2.4	1.6	1.5	1.3
4	4.8	5.2	.....	2.05	3.25	.....	.....	2.65	2.3	1.6	1.5	1.3
5	4.9	5.2	.....	1.75	3.3	.....	.....	2.55	2.3	1.6	1.5	1.3
6	4.7	5.1	.....	1.6	2.55	.....	.....	2.5	2.0	1.55	1.5	1.3
7	4.5	5.1	.....	1.9	.....	.....	.....	2.55	1.8	1.45	1.5	1.2
8	4.2	5.1	.....	2.1	.....	.....	.....	2.75	1.85	1.4	1.5	1.15
9	4.5	5.1	.....	2.1	.....	.....	.....	2.9	1.9	1.4	1.5	1.1
10	4.2	4.9	.....	2.1	.....	.....	.....	2.8	1.9	1.5	1.5	1.1
11	4.2	4.7	4.0	2.25	.....	.....	.....	2.8	1.9	1.4	1.5	1.1
12	4.3	4.8	.....	2.5	.....	.....	.....	2.8	2.0	1.4	1.5	1.2
13	4.4	4.8	.....	2.75	.....	.....	.....	2.8	2.0	1.4	1.5	1.2
14	4.4	4.8	.....	2.8	.....	.....	.....	2.9	2.0	1.4	1.5	1.3
15	4.3	4.7	.....	2.8	.....	.....	.....	2.8	2.0	1.35	1.5	1.3
16	4.4	4.8	.....	2.75	.....	.....	.....	2.8	2.0	1.3	1.5	.....
17	4.5	4.8	.....	2.55	.....	.....	.....	2.8	1.9	1.25	1.5	.....
18	4.5	.....	3.8	2.3	.....	.....	.....	2.75	1.8	1.2	1.4	3.7
19	4.6	.....	.....	2.05	.....	.....	.....	2.65	1.8	1.2	1.4	.....
20	4.5	.....	3.6	2.15	.....	.....	.....	2.6	1.8	1.2	1.35	.....
21	4.5	4.9	3.5	1.9	.....	.....	.....	2.6	1.8	1.2	1.3	.....
22	.....	.....	3.5	2.3	.....	.....	.....	2.5	1.7	1.2	1.3	.....
23	4.6	.....	3.5	2.4	.....	.....	.....	2.5	1.7	1.2	1.15	.....
24	4.9	4.7	3.5	2.0	.....	.....	.....	2.5	1.7	1.2	1.1	.....
25	4.9	.....	3.4	2.0	.....	.....	.....	2.85	1.7	1.45	1.2	3.4
26	4.9	.....	2.55	2.15	.....	.....	.....	2.75	1.6	1.55	1.2	.....
27	5.0	.....	2.3	2.55	.....	.....	.....	2.75	1.5	1.7	1.2	.....
28	5.0	.....	2.35	2.65	.....	.....	.....	2.75	1.4	1.7	1.2	.....
29	5.0	.....	2.25	2.65	.....	.....	.....	2.75	1.5	1.7	1.2	.....
30	5.0	.....	2.0	2.55	.....	.....	.....	2.7	1.6	1.6	1.3	.....
31	5.0	.....	2.3	.....	.....	.....	.....	2.7	.....	1.6	.....	.....

NOTE.—Ice conditions January 1 to March 26 and December 16–31: January 24, gage reader estimates backwater effect of 0.2 foot due to ice; channel open 80 feet wide at the gage. January 29, channel open about 10 feet wide at the gage. February 1, river frozen over at the gage. Most of the ice went out during the week of March 20–26. December 18, rise in river due to anchor ice; estimated gage height, 2.1 feet. During frozen period gage heights are to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 21	4.9	4.9	0.2
February 24	4.7	4.7	.8
March 3	4.5	4.1	.9
March 11	4.0	4.2	1.0
March 18	3.8	3.8	1.0
December 18	3.7	3.7	.25
December 25	3.4	3.4	.3

From about May 1 to July 31 considerable fluctuations in gage heights, amounting to from 2 to over 5 feet, occur daily, due to the regulating of the flow at Indian Pond dam for the purpose of log driving. The morning and evening records obtained by the observer represented the maximum and minimum heights of each day during this period as well as could be determined. The range of the morning readings, May 7 to July 31, was 4.0 to 7.6 feet, and of the evening readings 1.5 to 2.5 feet.

Station rating table for Kennebec River at The Forks, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	630	2.00	1,305	2.90	2,325	3.80	3,825
1.20	695	2.10	1,395	3.00	2,470	4.00	4,220
1.30	765	2.20	1,490	3.10	2,620	4.20	4,635
1.40	835	2.30	1,590	3.20	2,775	4.40	5,070
1.50	910	2.40	1,700	3.30	2,935	4.60	5,535
1.60	985	2.50	1,815	3.40	3,100	4.80	6,020
1.70	1,060	2.60	1,935	3.50	3,270	5.00	6,525
1.80	1,140	2.70	2,060	3.60	3,450		
1.90	1,220	2.80	2,190	3.70	3,635		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1901–1905. It is well defined between gage heights, 1.1 feet and 5 feet. The extension above 5 feet is based on the extension of the area and velocity curves, the latter being determined by means of tables based on Kutter's formula.

Estimated monthly discharge of Kennebec River at The Forks, Me., for 1905.

[Drainage area, 1,670 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile	Depth in inches.
March 26–31	1,875	1,305	1,591	0.953	0.213
April	2,400	985	1,666	.998	1.11
May [a]	6,700	1,645	4,330	2.59	2.99
June [a]	8,330	4,780	5,408	3.24	3.62
July [a]	5,310	2,980	4,065	2.43	2.80
August	2,935	835	2,067	1.24	1.43
September	2,060	835	1,248	.747	.833
October	1,060	695	864	.517	.596
November	985	630	838	.502	.560
December 1–15	765	630	717	.429	.239

[a] The mean daily discharge, May 7 to July 31, was computed by averaging the discharges as applied to the morning and evening gage heights, taking account also of the relative length of the high and low water periods.

KENNEBEC RIVER NEAR NORTH ANSON, ME.

This station was established October 18, 1901, by N. C. Grover. It is located 1½ miles east of North Anson, above the mouth of Carrabassett River.

The channel is straight for 500 feet above and 1,000 feet below the station, and has a width of about 350 feet, broken by one pier. The current is swift at high stages and moderately rapid at low stages, except near the left bank. The right bank is high and rocky. The left bank is comparatively low and subject to overflow at the time of highest water. The bed of the stream is rocky, with sand over a portion of the section, and is permanent.

Discharge measurements are made from the wooden highway bridge across the Kennebec, known locally as Patterson Bridge. The initial point for soundings is on the left bank, at the outside of the end post of the center truss of the bridge. Low-water measurements are made from a boat about 1,000 feet below the station, at a section where there is a better distribution of current.

Gage readings are made twice each day by Mrs. C. S. Benjamin, the toll collector at the bridge. There are three gages—one, for ordinary stages, is a vertical rod fastened to the bridge pier; another, for high-water observations, is a vertical rod attached to the right abutment; the third, for low-water stages, is a standard chain gage attached to the wooden truss on the upstream side of the bridge. The length of the chain was 30.40 feet when the gage was established, but changed to 30.36 feet July 26, 1904, and to 30.23 feet July 19, 1905, owing to settling of the bridge. The gage datum is 241.24 feet above mean sea level, as determined by the Kennebec River survey of 1904. The datum of the three gages is the same and is referred to four bench marks, as follows: (1) Top of pier back of the gage; elevation, 22.50 feet. (2) Top of the southeast corner of the twelfth stone from the top of west abutment; elevation, 9.55 feet. (3) Copper bolt in bowlder on right bank about 100 feet above the bridge; elevation, 10.66 feet. (4) Marked point on the bottom chord of the bridge near the chain gage; elevation, 25.15 feet originally; changed to 25.03 feet July 26, 1904, and to 24.91 feet July 19, 1905. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 16–17; 82, pp 28–29; 97, pp 45–46; 124, pp 59–60.
Discharge: 65, p 17; 82, p 29; 97, p 46; 124, p 60.
Discharge, monthly: 97, p 48; 124, p 62.
Gage heights: 65, p 17; 82, p 29; 97, p 47; 124, p 61.
Rating table: 97, p 47; 124, p 62.

Discharge measurements of Kennebec River near North Anson, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
February 9 [a]	Barrows and Norcross	458	1,390	1.50	5.27	2,080
February 9 [a]	do	458	1,390	1.54	5.32	2,110
April 19	F. E. Pressey	304	2,150	2.33	4.26	5,000
July 20	do	295	1,930	1.95	3.72	3,770
October 27	do	277	1,460	.90	2.30	1,320

[a] Gage height to top of ice, 5.42 feet. Thickness of ice at gage, 2.65 feet. Average thickness of ice at measuring section, 2 feet.

Daily gage height, in feet, of Kennebec River near North Anson, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				9.45				2.95	3.25	2.3	2.2	3.65
2				8.55				3.45	3.2	2.3	2.25	
3				8.95				4.15	2.95	2.3	2.15	
4		5.35	5.25	9.4				3.45	2.95	2.3	2.3	
5				8.4				3.3	3.1	2.3	2.2	
6				8.1				3.2	3.05	2.25	2.3	
7	5.65			8.9				3.3	2.95	2.1	2.3	
8		5.25		9.25				3.35	2.9	2.1	2.3	
9				8.5				3.4	2.75	2.1	2.3	3.45
10				7.0				3.35	2.75	2.1	2.35	
11		4.9	4.95	5.35				3.35	2.65	2.1	2.25	
12				5.5				3.3	2.55	2.1	2.2	
13				5.5				3.3	2.6	2.05	2.2	
14	6.55			4.9				3.4	2.5	2.0	2.25	
15				5.05				3.45	2.55	2.0	2.2	
16				4.9				3.45	2.65	2.1	2.15	3.35
17				4.65				3.35	2.4	2.05	2.4	3.35
18		5.15	4.85	4.5				3.55	2.7	2.1	2.8	3.45
19				4.3				3.5	2.75	1.95	2.1	
20				4.3				3.4	2.75	1.9	1.95	
21	5.65			4.35				3.2	2.85	1.9	2.1	
22				4.95				3.05	2.8	1.9	2.0	5.65
23				4.65				3.05	2.7	2.0	2.0	
24				4.7				2.95	2.6	1.95	2.1	
25		5.45	5.15	4.75				2.95	2.5	2.0	2.1	
26				4.4				3.15	2.35	2.05	2.15	
27			6.8	4.95				2.7	2.35	2.25	2.3	
28	5.55		6.9	4.7				2.4	2.3	2.2	2.45	5.75
29			7.9	4.9				2.7	2.3	2.25	2.7	
30			8.45	4.95				3.35	2.3	2.3	2.95	
31			8.95					3.2		2.2		

NOTE.—River frozen January 1 to about March 27, when river was probably clear of ice. Also ice conditions December 1-31; the river being closed with the exception of channels in each span, which were probably open during the whole month. Gage heights December 18, 22, and 28 probably affected by backwater from anchor ice. During frozen period gage heights are to the surface of the water in a hole cut in the ice. The ice thickness was measured as follows:

	Feet.		Feet.
January 7	1.9	March 18	2.7
January 14	2.2	March 25	2.5
January 21, 28, February 4	2.3	December 9	.4
February 8, 11, 18	2.2	December 16, 17	.6
February 25, March 4	2.4	December 18, 22	.7
March 11	2.3	December 28	1.0

Fluctuations in the gage heights occur from about May 1 to July 31, as at The Forks, but in less marked degree. (See note to gage-height table, Kennebec at The Forks, p. 54.)

Station rating table for Kennebec River near North Anson, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	990	2.90	2,184	3.90	4,169	4.90	6,532
2.00	1,080	3.00	2,450	4.00	4,385	5.00	6,790
2.10	1,182	3.10	2,621	4.10	4,606	5.20	7,316
2.20	1,294	3.20	2,797	4.20	4,832	5.40	7,858
2.30	1,415	3.30	2,978	4.30	5,062	5.60	8,415
2.40	1,544	3.40	3,164	4.40	5,297	5.80	8,984
2.50	1,680	3.50	3,355	4.50	5,536	6.00	9,565
2.60	1,822	3.60	3,551	4.60	5,779		
2.70	1,970	3.70	3,752	4.70	6,026		
2.80	2,024	3.80	3,958	4.80	6,277		

NOTE.—The above table is applicable only for open channel conditions. It is based on five discharge measurements made during 1904–5 and the form of the 1904 curve. It is well defined between gage heights 2.3 feet and 5 feet.

Estimated monthly discharge of Kennebec River near North Anson, Me., for 1905.

[Drainage area, 2,880 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 27–31	18,840	11,970	15,140	5.26	0.978
April	20,480	5,060	10,180	3.53	3.94
May[a]	12,000	6,940	8,704	3.02	3.48
June[a]	9,390	5,230	7,050	2.45	2.73
July[a]	9,110	2,380	5,481	1.90	2.19
August	4,720	1,544	2,896	1.01	1.16
September	2,885	1,415	1,970	.684	.763
October	1,415	990	1,205	.418	.482
November	2,265	1,035	1,385	.481	.537

[a] From May 1 to July 31, during the log-driving season, the discharge is a mean of the discharges corresponding to gage heights of the high and low daily periods, considering each period as lasting twelve hours.

KENNEBEC RIVER AT WATERVILLE, ME.

The only long-continued observations of the flow of the Kennebec are those which have been made at Waterville by the Hollingsworth & Whitney Company, which kindly furnishes the results for publication. The works of that company are above the mouth of Sebasticook River. Observations are made at 12 o'clock noon of each day, that hour having been chosen, after investigation, as a time when the flow is least affected by storage at dams upstream and as giving most nearly the average for the day.

When the flow of the river is less than 3,500 second-feet the whole amount is diverted through the water wheels of the mill, of which there are 48. Water in excess of the above amount is wasted over the dam. All the wheels have been tested at Holyoke under practically the same head as used at Waterville. Discharge curves for the wheels and for overflow of the dam, both with and without flashboards, were constructed several years ago by Sumner Hollingsworth. Estimates of

daily flow are made by means of these diagrams. The leakage through the crib dam has never been measured, but 100 second-feet are added arbitrarily to cover this item.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, pp 64-65; WS 27, p 9; 35, p 25; 47, p 29; 82, p 30; 97, pp 48-49; 124, pp 62-63.
Discharge: Ann 19, iv, p 72.
Discharge, daily: WS 27, pp 11-14; 35, p 26; 47, p 30; 82, pp 30-31; 97, p 49; 124, p 63.
Discharge, monthly: Ann 19, iv, pp 75-78; 20, iv, p 65; 21, iv, p 52; 22, iv, p 57; WS 82, pp 31-32.
Discharge, yearly: Ann 20, iv, p 46.
Hydrographs: Ann 19, iv, pp 72, 73, 74; 20, iv, p 65; 21, iv, p 53; 22, iv, p 58.
Rainfall and run-off relation: Ann 19, iv, p 74.

Daily discharge, in second-feet, of Kennebec River at Waterville, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,116	3,366	2,645	32,125	10,038	6,501	5,275	5,114	3,077	2,390	2,113	2,809
2	2,256	3,125	2,532	22,278	13,593	7,755	5,040	4,108	2,466	2,205	2,252	2,524
3	3,421	3,422	2,366	16,278	8,680	6,597	5,450	4,401	100	2,433	1,965	1,485
4	2,847	2,868	2,521	14,471	7,113	6,102	8,591	4,018	3,363	2,086	1,952	2,814
5	2,737	2,123	714	10,854	12,907	8,371	7,554	3,496	3,912	1,852	100	3,932
6	2,545	3,225	2,815	11,303	18,324	7,113	6,363	2,090	4,603	1,598	1,960	3,065
7	2,872	2,956	2,202	25,578	11,542	7,480	5,962	3,962	4,350	2,143	2,867	3,133
8	2,094	2,569	2,431	19,498	10,545	5,123	5,422	2,940	4,015	100	2,830	2,784
9	3,699	2,556	2,257	15,715	10,425	6,815	3,434	3,133	3,904	1,813	3,067	2,835
10	3,912	2,484	2,555	12,342	10,923	6,026	4,937	3,397	2,348	2,089	3,113	1,202
11	3,659	2,553	2,541	12,394	11,251	6,119	4,836	2,810	3,596	2,229	2,843	2,499
12	4,182	1,859	2,278	15,260	9,696	6,780	5,024	3,048	3,071	1,879	1,825	2,197
13	3,915	3,158	2,855	15,780	8,440	7,333	5,015	100	3,055	1,875	3,059	1,639
14	3,623	2,475	2,530	27,954	9,109	9,251	4,948	3,909	2,813	1,681	2,514	1,735
15	2,317	2,538	2,273	11,928	9,559	8,493	4,864	3,036	2,990	141	2,810	1,786
16	3,642	2,548	2,208	14,340	8,699	7,386	3,803	3,310	2,998	2,478	1,957	1,520
17	3,108	2,570	2,245	11,456	10,196	6,071	5,025	3,345	1,828	2,428	2,011	1,166
18	3,425	2,546	2,247	12,690	11,441	5,548	4,298	3,822	2,466	2,432	2,840	1,308
19	3,103	1,842	1,553	7,065	14,315	5,881	4,676	2,819	3,616	2,351	1,838	1,327
20	3,099	3,033	2,561	6,291	14,279	6,678	5,002	2,642	4,286	1,817	2,840	1,690
21	3,324	2,547	2,615	7,486	9,711	6,108	5,301	3,653	2,936	1,836	2,243	1,713
22	2,296	2,541	2,849	10,164	8,788	7,433	3,969	3,344	3,663	100	2,390	2,221
23	3,654	2,545	3,384	12,934	10,174	6,678	2,814	3,372	3,937	1,118	1,913	1,748
24	2,766	2,529	3,447	11,205	11,269	6,325	3,997	2,998	1,370	1,555	1,983	914
25	2,825	2,811	3,701	7,878	8,403	5,109	3,648	2,922	3,636	2,397	1,450	2,050
26	2,849	1,200	3,349	8,294	11,298	6,017	3,372	2,955	3,169	1,903	1,216	1,930
27	3,145	3,119	13,250	7,081	10,583	6,633	3,828	1,528	2,802	1,687	3,452	1,996
28	3,430	2,520	15,245	8,881	10,120	6,739	3,308	3,635	2,503	1,936	2,843	2,025
29	1,831	.....	20,950	8,901	8,241	6,672	3,473	3,087	2,206	100	2,547	2,620
30	3,700	.....	21,365	6,608	8,153	5,845	1,491	3,054	142	1,645	2,378	2,062
31	3,150	.....	26,230	.....	8,202	.....	3,986	3,161	.....	2,484	.....	1,212

Estimated monthly discharge of Kennebec River at Waterville, Me., for 1905.

[Drainage area, 4,380 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,182	1,831	3,082	0.704	0.812
February	3,422	1,200	2,630	.600	.625
March	26,230	714	5,249	1.20	1.38
April	32,120	6,291	13,500	3.08	3.44
May	18,320	7,113	10,520	2.40	2.77
June	9,251	5,109	6,699	1.53	1.71
July	8,591	1,491	4,668	1.07	1.23
August	5,114	100	3,198	.730	.842
September	4,603	100	2,974	.679	.758
October	2,484	100	1,767	.403	.465
November	3,452	100	2,306	.526	.587
December	3,932	914	2,063	.471	.543
The year	32,120	100	4,888	1.12	15.16

MOOSE RIVER, NEAR ROCKWOOD, ME.

This station was established September 7, 1902, by N. C. Grover. It is located 4 miles west of Kineo, Me., near the village of Rockwood, and 2 miles from the mouth of the river. Water is stored by dams at the outlets of several of the lakes and ponds in the basin above, but all of such stored water is used for log driving. The stage of the river changes very slowly after the end of the log-driving season. Practically all of the land areas in this basin are in forest.

The channel is straight above and below the station, and is about 220 feet wide at ordinary stages. The banks are high and rocky; the bed of the stream is rocky and permanent; the current is swift at high and medium at low stages.

Discharge measurements are made from a car suspended from a steel cable or by wading at low stages a short distance downstream. The initial point for soundings is on the right bank, 1 foot from a birch tree to which the cable and tag line are fastened.

Gage readings are made twice each day by Peter Callaghan. A standard chain gage is attached to trees on the bank, and is referred to bench marks as follows: (1) Copper bolt in bowlder 8 feet from corner of house of Peter Callaghan; elevation, 14.58 feet. (2) Highest point of large bowlder on right bank 150 feet below the cable; elevation, 5.75 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of United States Geological Survey:

Description: 82, p 36; 97, pp 49-50; 124, p 64.
Discharge: 82, p 36; 97, p 50.
Gage heights: 82, p 36; 97, p 50; 124, p 64.

Discharge measurements of Moose River near Rockwood, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 21	Barrows and Pressey	253	1,400	2.47	6.41	3,460
July 10	Pressey and Adams	232	700	1.36	3.58	950
Aug. 14[a]	H. K. Barrows	110	170	1.65	2.02	280
Nov. 2[b]	F. E. Pressey	107	88	1.26	1.56	111
Nov. 10[b]	do	121	114	1.41	1.72	161

[a] By wading 200 feet below cable. [b] By wading 150 feet below cable.

Daily gage height, in feet, of Moose River near Rockwood, Me., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.95	4.6	4.05	2.55	2.0	1.8	1.5	1.8
2	.....	5.95	4.4	4.05	2.5	2.0	1.8	1.6	1.8
3	4.2	6.05	4.55	4.1	2.4	2.0	1.8	1.5	1.8
4	4.45	6.2	4.55	4.1	2.4	2.0	1.8	1.55	1.9
5	4.7	6.3	4.75	4.1	2.3	2.05	1.8	1.6	1.9
6	4.95	6.45	4.6	4.0	2.3	2.1	1.8	1.6	1.9
7	5.0	6.6	4.5	.....	2.3	2.1	1.7	1.65	1.9
8	5.15	6.7	4.65	3.85	2.2	2.1	1.7	1.7	1.9
9	5.25	6.85	4.9	3.7	2.2	2.05	.....	1.7	1.9
10	.....	6.85	5.15	3.6	2.2	2.0	.....	1.7	2.0
11	5.3	6.9	5.0	3.5	2.2	2.0	1.7	1.7	2.0
12	5.4	6.85	5.2	3.4	2.2	2.0	1.6	1.7	2.0
13	5.5	6.7	5.1	3.35	2.15	2.0	1.7	1.7	2.0
14	5.65	6.6	5.1	3.25	2.1	1.9	1.7	.....	2.0
15	5.8	6.35	.....	3.2	2.1	1.9	1.7	.....	2.0
16	5.85	6.1	4.7	3.1	2.1	1.8	1.7	.....	2.0
17	5.8	5.8	4.65	3.05	2.1	1.8	1.6	1.8	2.0
18	5.45	5.7	4.7	3.0	2.05	1.85	1.6	1.8	2.0
19	5.2	6.0	4.6	3.0	2.0	1.9	1.6	1.8	1.9
20	5.15	6.5	4.6	2.95	2.0	1.9	1.6	1.8	1.9
21	5.15	6.5	4.6	2.85	2.0	1.9	1.7	1.8	1.9
22	5.25	6.35	4.6	2.8	2.0	1.9	1.7	1.7	1.9
23	5.3	6.15	4.55	2.8	2.0	1.9	1.65	1.7	1.9
24	5.35	5.9	4.45	2.7	2.0	1.9	1.6	1.8	1.9
25	5.35	5.75	4.4	2.7	2.0	1.9	1.6	1.8	1.9
26	5.35	5.45	4.3	2.6	2.0	1.9	1.6	1.8	.....
27	5.45	5.55	4.3	2.6	2.1	1.9	1.6	1.8	1.9
28	5.6	5.45	4.3	2.6	2.1	1.8	1.6	1.8	1.9
29	5.8	5.3	4.25	2.6	2.0	1.8	1.6	1.8	1.9
30	5.9	5.4	4.2	2.6	2.0	1.8	1.5	1.8	1.9
31	.....	5.05	.....	2.6	2.0	.....	1.5	.....	1.9

NOTE.—River frozen January 1 to April 2. November 14–16, gage heights omitted, owing to backwater, due to ice.

Station rating table for Moose River near Rockwood, Me., from September 4, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	70	2.50	414	3.70	1,032	4.90	1,964
1.40	88	2.60	454	3.80	1,098	5.00	2,055
1.50	108	2.70	496	3.90	1,166	5.20	2,240
1.60	130	2.80	539	4.00	1,236	5.40	2,432
1.70	154	2.90	584	4.10	1,308	5.60	2,629
1.80	180	3.00	631	4.20	1,382	5.80	2,830
1.90	208	3.10	681	4.30	1,459	6.00	3,035
2.00	238	3.20	733	4.40	1,538	6.20	3,245
2.10	270	3.30	788	4.50	1,620	6.40	3,455
2.20	303	3.40	846	4.60	1,703	6.60	3,670
2.30	338	3.50	906	4.70	1,788	6.80	3,890
2.40	375	3.60	968	4.80	1,875	7.00	4,110

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1902–1905. It is well defined between gage heights 1.5 feet and 6.5 feet.

Estimated monthly discharge of Moose River near Rockwood, Me., for 1902–1905.

[Drainage area, 680 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
September 4–30	1,098	375	682	1.00	1.00
October	1,708	733	919	1.35	1.56
November	1,708	968	1,237	1.82	2.03
December	906	539	652	.959	1.11
1903.					
January 1–10	539	454	513	.754	.280
March 21–31	4,628	2,679	3,874	5.70	2.33
April	4,055	2,432	3,061	4.50	5.02
July 7–31	496	375	454	.668	.621
August	631	270	462	.679	.783
September	303	98	184	.271	.302
October	130	88	101	.149	.172
November	180	88	131	.193	.215
December 1–16	154	88	124	.182	.107
1904.					
April 10–30	3,140	154	1,492	2.19	1.71
May	6,500	1,920	4,026	5.92	6.82
June (27 days)	2,194	1,236	1,646	2.42	2.43
July	1,308	338	704	1.04	1.20
August	454	254	358	.526	.606
September	1,538	303	801	1.18	1.32
October	2,055	1,032	1,420	2.09	2.41
November	1,000	454	649	.954	1.06
December 1–10	454	303	370	.544	.202
1905.					
April 3–30	2,932	1,382	2,358	3.46	3.60
May	4,000	2,102	3,189	4.69	5.41
June	2,240	1,382	1,742	2.56	2.86
July	1,308	454	795	1.17	1.35
August	434	238	287	.422	.486
September	270	180	220	.324	.362
October	180	108	147	.216	.249
November 1–13, 17–30	180	108	158	.232	.233
December	238	180	214	.315	.363

NOTE.—River frozen January 11 to March 20 and December 17–31, 1903; January 1 to April 9 and December 11–31, 1904; January 1 to April 2, 1905. Above estimates for 1903 and 1904 do not apply to the gage heights published in the 1903 and 1904 reports, as there was an uncorrected gage in those years; 1905, discharge interpolated on days when gage heights were not read, except November 14–16.

MISCELLANEOUS DISCHARGE MEASUREMENTS IN MOOSE RIVER BASIN.

The following miscellaneous discharge measurements were made in the Moose River basin in 1905:

Miscellaneous discharge measurements made in Moose River drainage basin in 1905.

Date.	Hydrographer.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
				Feet.	*Sq. feet.*	*Ft. p. sec.*	*Feet.*	*Sec.-ft.*
Aug. 11	Barrows and Pressey.	Misery Stream ..	¼ mile above Brassua Lake.	15	4.64	0.92	[a] 2.12	4.25
Aug. 12	.....do....	Brassua Stream .	1½ miles above Brassua Lake.	6	4.06	1.23	[a] 2.12	5.02
Aug. 12	.....do....	Moose River	Just above Little Brassua Lake and about 4 miles above Brassua Lake.	90	126	1.91	[a] 2.12	241
Oct. 30	.....do....	.....do.....	At outlet of Wood Pond.	82	57	1.12	[b] 1,154.65	64
Oct. 31	.....do....	Gander Brook ..	Near entrance to Wood Pond.	2	.26	.35	[b] 1,154.65	.09
Oct. 31	.....do....	Little Wood Pond Stream.	.....do.....	11	3.1	1.23	[b] 1,154.65	3.8
Nov. 1	.....do....	Moose River	Just above Attean Pond. [c]	55	49	1.51	[d] 1,154.69	74

[a] Probable gage height at Rockwood gage.
[b] Height of Wood Pond.
[c] Measurement made in rapids; bed very rough and measurement considered not good. 0.42 inch rain fell at Jackman during night of October 31.
[d] Height of Wood Pond November 2 at noon.

ROACH RIVER AT ROACH RIVER, ME.

Roach River, which has a total drainage area of 120 square miles, enters Moosehead Lake from the east. Its basin is completely forested. Dams at the outlets of several ponds control the flow of the river. The gage is located about 100 feet downstream from the lowest of these dams, at which point the river is so completely under control that the stage does not vary perceptibly for weeks at a time. Impounded water is used for log driving.

This station was established November 10, 1901, by N. C. Grover. It is located near the village of Roach River.

The channel is straight and about 60 feet wide. The bed of the stream is rocky and permanent. The current is moderate.

Discharge measurements are made by wading or from a canoe at a section 140 feet downstream from the gage.

The gage, which is read twice each day by C. H. Sawyer, is a vertical rod spiked to the timber retaining wall on the right bank of the stream. It is referred to bench marks as follows: (1) A cross cut in the highest timber of the crib to which the gage is spiked; elevation, 8.84 feet. (2) Circular chisel draft marked "B. M." on highest point of bowlder near cottage on left bank, about opposite the dam; elevation, 12.57 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers, United States Geological Survey:

Description: 65, p 17; 82, pp 36–37; 97, p 51; 124, p 65.
Discharge: 82, p 37.
Discharge, monthly: 82, p 38; 97, p 52.
Gage heights: 65, p 18; 82, p 37; 97, p 51; 124, p 65.
Rating tables: 82, p 38; 97, p 52.

Discharge measurements of Roach River at Roach River, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 22[a]	Barrows and Pressey	120	258	2.78	4.07	718
May 22[a]	do	122	312	3.21	4.45	1,000
May 23[a]	do	112	188	2.79	3.59	524
November 7[b]	do	19	9.3	.58	1.95	5.4
November 7[b]	do	16	8.0	.42	1.90	3.4

[a] From canoe about 100 feet below gage. [b] By wading about 200 feet below gage.

Daily gage height, in feet, of Roach River at Roach River, Me., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.2	3.0	2.6	2.4	2.9	2.1	2.2	1.8
2	.....	2.2	4.2	2.6	2.4	2.9	2.1	2.2	1.8
3	.....	2.2	2.2	2.6	2.4	2.9	2.1	2.2	1.8
4	.....	2.2	4.8	2.6	2.4	2.8	2.1	2.2	1.8
5	.....	2.2	2.2	3.8	2.4	2.7	2.1	2.2	1.8
6	.....	2.2	2.2	3.5	3.5	2.65	2.1	2.2	1.8
7	.....	2.2	5.6	2.6	3.5	2.2	2.1	2.2	1.8
8	.....	2.2	3.9	2.6	3.5	2.2	2.1	2.2	1.8
9	.....	2.2	3.9	2.6	3.5	2.2	2.1	2.2	1.8
10	.....	2.2	5.6	2.6	3.5	2.2	2.1	2.2	1.8
11	.....	2.2	3.9	2.6	3.5	2.2	2.1	2.2	1.8
12	.....	2.2	2.2	2.6	3.5	2.2	2.1	2.2	1.8
13	.....	2.2	5.6	2.6	3.5	2.2	2.1	2.2	1.8
14	.....	2.2	2.2	3.0	3.4	2.2	2.1	2.2	1.8
15	.....	2.2	3.9	3.4	3.4	2.2	2.1	2.0	1.8
16	.....	2.2	5.6	3.0	3.4	2.2	2.1	2.0	1.8
17	.....	2.2	5.6	2.6	3.4	2.1	2.1	2.0	1.8
18	.....	2.2	2.2	2.5	3.3	2.1	2.1	2.0	1.8
19	.....	2.2	5.6	2.5	3.3	2.1	2.1	2.0	.....
20	.....	2.2	5.6	2.5	3.3	2.1	2.1	2.0	.....
21	2.4	2.2	5.6	2.5	3.3	2.1	2.1	2.0	1.7
22	2.4	2.2	5.05	2.5	3.3	2.1	2.1	2.0	.....
23	2.4	2.2	3.6	2.5	3.3	2.1	2.1	2.0	.....
24	2.4	2.2	2.6	2.5	3.2	2.1	2.2	2.0	.....
25	2.4	3.0	2.6	2.4	3.2	2.1	2.2	2.0	.....
26	2.4	3.0	2.6	2.4	3.2	2.1	2.2	2.0	.....
27	2.4	3.0	2.6	2.4	3.1	2.1	2.2	2.0	.....
28	2.4	3.0	2.6	2.4	3.1	2.1	2.2	2.0	.....
29	2.2	3.0	2.6	2.4	3.1	2.1	2.2	2.0	.....
30	2.2	3.0	2.6	2.4	3.0	2.1	2.2	2.0	.....
31	2.2	.....	2.6	.....	3.0	2.1	.....	2.0	.....

NOTE.—River frozen January 1 to March 20 and November 19 to December 31. November 21, gage height to top of ice, 1.8 feet; thickness of ice, 0.1 foot.

Station rating table for Roach River at Roach River, Me., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	0.8	2.70	186	3.80	640	4.90	1,170
1.85	1.5	2.80	221	3.90	685	5.00	1,225
1.90	3.4	2.90	258	4.00	730	5.10	1,280
1.95	6.5	3.00	298	4.10	775	5.20	1,335
2.00	12	3.10	338	4.20	820	5.30	1,390
2.10	27	3.20	379	4.30	865	5.40	1,445
2.20	46	3.30	421	4.40	915	5.50	1,500
2.30	68	3.40	463	4.50	965	5.60	1,555
2.40	94	3.50	506	4.60	1,015		
2.50	122	3.60	550	4.70	1,065		
2.60	153	3.70	595	4.80	1,115		

NOTE.—The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1902–1905. It is not well defined.

Estimated monthly discharge of Roach River at Roach River, Me., for 1904–5.

[Drainage area, 85 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 26–31	68	68	68.0	0.800	0.178
April	820	46	96.0	1.13	1.26
May	1,528	68	912	10.73	12.37
June	1,500	68	456	5.36	5.98
July	298	46	83.4	.981	1.13
August	730	46	182	2.14	2.47
September	221	46	80.8	.952	1.06
October	463	68	149	1.75	2.02
November	68	27	29.0	.341	.380
1905.					
March 21–31	94	46	80.9	.952	.389
April	298	46	96.4	1.13	1.26
May	1,555	46	668	7.86	9.06
June	640	94	182	2.14	2.39
July	506	94	376	4.42	5.10
August	258	27	71.5	.841	.970
September	46	27	31.4	.369	.412
October	46	12	27.4	.322	.371
November 1–18	.8	.8	.8	.0094	.0069

NOTE.—River frozen January 1 to March 25 and December 4–31, 1904; January 1 to March 20 and November 19 to December 31, 1905.

DEAD RIVER NEAR THE FORKS, ME.

Dead River has its headwaters in the mountains between Maine and Canada and flows in a general easterly direction, entering the Kennebec at The Forks. Its basin is 40 miles in extreme length by 30 miles in width and is almost entirely covered with forests. Through a large portion of its length the river flows through swamps; in its lower course it has considerable fall. The only dams on the stream are owned by the log-driving companies, and the gates are kept open after the drives are out of the river.

This gaging station was established September 29, 1901, by N. C. Grover. It is located 1½ miles west of The Forks.

The channel is straight for 500 feet above and below the station and is about 225 feet wide at ordinary stages. The banks are rocky and are subject to overflow in extreme freshets. The bed is rocky and permanent. The current is rapid.

Discharge measurements are made from a car suspended from a steel cable.

The gage, which is read twice each day by Jeremiah Durgin, jr., is a vertical rod attached to a large bowlder on the left bank about 700 feet below the cable. It is referred to a bench mark, a copper bolt set in a bowlder 9.5 feet from the gage; elevation, 7.97 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 18; 82, pp 34-35; 97, p 53; 124, p 66.
Discharge: 65, p 18; 82, p 35; 97, p 53; 124, p 66.
Gage heights: 65, p 18; 82, p 35; 97, p 54; 124, p 67.

Discharge measurements of Dead River near The Forks, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 21	F. E. Pressey	235	685	2.64	1.82	1,810
June 1	do	233	660	2.30	1.76	1,520
June 1	do	233	660	2.29	1.75	1,510
July 18	do	220	470	1.47	1.09	690

Daily gage height, in feet, of Dead River near The Forks, Me., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.6	3.9	2.6	1.75	1.85	0.75	0.75	0.75	1.15
2	.....	3.35	4.15	2.55	2.2	1.85	.75	.75	.85	1.1
3	.....	3.4	3.55	1.9	2.3	1.55	.75	.75	.85	1.05
4	.....	2.9	5.85	1.7	2.4	1.4	.85	.75	.85	1.05
5	.....	2.6	4.25	1.65	2.2	1.2	.95	.75	.85	1.15
6	.....	2.45	4.05	1.65	2.0	1.0	1.05	.75	.85	1.15
7	.....	2.35	4.2	1.75	1.8	1.0	1.2	.75	.85	1.15
8	.....	2.35	4.25	1.65	1.6	1.05	1.25	.65	.95	1.15
9	.....	2.35	4.15	1.6	1.5	1.05	1.1	.65	.95	1.15
10	.....	2.45	4.3	1.55	1.45	1.05	.95	.65	.95	1.15
11	.....	2.45	4.55	1.55	1.35	1.05	.95	.65	.85	1.15
12	.....	2.65	4.15	1.8	1.45	.95	.85	.65	.75	1.05
13	.....	2.5	4.0	2.3	1.3	.95	.75	.65	.75	1.05
14	.....	2.3	3.8	2.2	1.2	1.05	.75	.65	.85	1.05
15	.....	2.35	3.5	1.95	1.1	1.05	.75	.75	.85	1.05
16	.....	2.35	5.7	1.85	1.05	1.15	.75	.75	.85	1.05
17	.....	2.95	5.05	1.85	1.0	1.3	.75	.75	.85	.....
18	.....	2.85	4.05	1.75	1.05	1.45	.9	.75	.95	.....
19	.....	2.2	3.8	2.0	1.25	1.3	1.1	.75	.95	.....
20	.....	1.9	5.2	2.3	1.65	1.15	1.15	.75	.95	.....
21	.....	2.4	5.1	2.65	1.95	1.15	1.05	.75	.95	.....
22	.....	3.25	4.85	2.65	1.35	1.05	.95	.75	.85	.....
23	.....	4.95	4.65	2.4	1.1	1.05	.95	.75	.85	.....
24	.....	2.35	4.75	2.2	1.1	1.05	.95	.75	.85	.....
25	.....	2.3	4.6	2.05	1.15	.95	.9	.75	.85	.....
26	.....	2.15	5.15	2.05	1.15	.95	.8	.75	.95	.....
27	.....	2.3	4.35	1.95	1.05	.85	.75	.75	.95	.....
28	4.85	3.2	4.45	1.95	.95	.85	.75	.75	1.05	.....
29	3.35	3.4	4.55	1.85	.95	.85	.75	.65	1.15	.....
30	2.8	3.15	4.15	1.75	.95	.75	.75	.65	1.15	.....
31	3.5	.....	2.85	.....	1.5	.75	.....	.65	.....	.....

NOTE.—River frozen January 1 to March 27; ice went out March 28 and river clear. River frozen December 16-31.

Station rating table for Dead River near The Forks, Me., from June 25, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	45	1.40	1,090	2.40	2,600	3.80	5,830
.50	110	1.50	1,225	2.50	2,780	4.00	6,430
.60	185	1.60	1,365	2.60	2,970	4.20	7,060
.70	270	1.70	1,505	2.70	3,160	4.40	7,730
.80	365	1.80	1,650	2.80	3,360	4.60	8,420
.90	470	1.90	1,795	2.90	3,570	4.80	9,140
1.00	580	2.00	1,945	3.00	3,790	5.00	9,890
1.10	700	2.10	2,100	3.20	4,240	5.50	11,920
1.20	825	2.20	2,260	3.40	4,730	6.00	14,080
1.30	955	2.30	2,430	3.60	5,260		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1903-1905. It is well defined between gage heights 0.7 foot and 2 feet; above 2 feet the table is subject to error of a few per cent.

Estimated monthly discharge of Dead River near The Forks, Me., for 1902–1905.

[Drainage area, 870 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
June 25–30	8,215	1,365	4,855	5.58	1.22
July	2,913	185	954	1.09	1.26
August	2,600	270	991	1.14	1.31
September	1,795	365	1,022	1.17	1.30
October	3,360	365	942	1.08	1.24
November	3,360	318	1,226	1.41	1.57
1903.					
June 4–30	9,140	470	1,748	2.01	2.02
July	1,225	470	646	.743	.857
August	1,090	470	648	.745	.859
September	470	110	222	.255	.284
October	270	110	172	.198	.228
November	580	270	357	.410	.457
1904.					
April 10–30	14,300	1,650	3,722	4.28	3.34
May	18,040	1,870	8,892	10.22	11.78
June	8,960	640	2,969	3.41	3.80
July	1,505	228	705	.810	.934
August	1,505	228	495	.569	.656
September	1,722	318	967	1.11	1.24
October	3,900	762	1,770	2.03	2.34
November	1,022	525	741	.852	.951
December 1–10	1,090	525	712	.818	.304
1905.					
April	9,700	1,795	3,352	3.85	4.30
May	13,420	3,465	7,821	8.99	10.36
June	3,065	1,295	1,955	2.25	2.51
July	2,600	525	1,180	1.36	1.57
August	1,722	318	739	.849	.979
September	890	318	475	.546	.609
October	318	228	289	.332	.383
November	762	318	470	.540	.602
December 1–16	762	640	705	.810	.482

NOTE.—Estimates for December, 1902, and December, 1903, omitted on account of ice conditions. River frozen January 1 to April 9 and December 11–31, 1904; January 1 to March 27 and December 17–31, 1905.

CARRABASSETT RIVER AT NORTH ANSON, ME.

Carrabassett River enters the Kennebec from the west at North Anson. Its basin has steep slopes, partly in farm lands, with no large natural reservoirs. Dams have been constructed and power used at New Portland, East New Portland, and North Anson.

The gaging station was established October 19, 1901, by N. C. Grover. It is located above Embden Brook and below Anson Brook.

The channel is straight for 500 feet above and 300 feet below the station and is about 150 feet wide, divided into two parts at low stages of the river by a gravelly bar. The bed is of coarse gravel and permanent, and the current is moderately rapid.

Discharge measurements are made by wading at low stages and from a boat at high stages.

Gage readings are taken once each day by N. Q. Hilton. There are two gages. One is a vertical rod attached to a tree; the other is a standard chain gage attached to trees on the bank. The length of the chain is 36.73 feet. The datum of the two

gages is the same, and is referred to two bench marks: (1) Point on root of a blazed spruce tree 40 feet from the vertical gage; elevation, 10.78 feet. (2) Copper bolt set in a large bowlder at the outlet of Anson Brook; elevation, 11.40 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 19; 82, p 32; 97, pp 54-55; 124, pp 67-68.
Discharge: 82, p 33; 97, p 55; 124, p 68.
Discharge, monthly: 82, p 34; 97, p 56; 124, p 70.
Gage heights: 65, p 19; 82, p 33; 97, p 55; 124, p 69.
Rating table: 82, p 34; 124, p 70.

Discharge measurements of Carrabassett River at North Anson, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
July 20 [a]	F. E. Pressey	133	187	2.33	1.18	435
October 26 [b]	do	102	90	1.62	.40	146

[a] Log jam in left channel 500 feet below gage. [b] Wading near gage.

Daily gage height, in feet, of Carrabassett River at North Anson, Me., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.0	2.3	1.0	0.9	2.9	0.3	0.4	0.4	1.0
2		2.8	2.0	.9	.9	1.5	.3	.4	.6	1.1
3		2.3	1.4	.9	2.7	1.2	.3	.4	.6	.7
4		2.1	3.6	1.0	1.9	.9	2.2	.4	.6	1.1
5		1.9	3.1	.8	1.5	.7	1.4	.4	.7	1.4
6		4.0	2.6	.8	1.2	.7	1.9	.4	.7	1.2
7		3.6	2.6	1.0	1.0	.6	1.4	.4	.8	.9
8		2.7	2.5	.8	.9	.9	1.2	.3	1.0	1.0
9		2.2	2.0	.7	.8	.8	1.0	.4	.8	.8
10		2.2	2.1	.7	.8	.7	.8	.4	.8	.8
11		2.9	1.7	.6	.8	.6	.7	.3	.6	.8
12		2.7	1.5	.7	.7	.5	.6	.3	.7	.6
13		2.8	1.5	3.8	.6	.5	.7	1.0	.8	.6
14		2.7	1.6	2.4	.5	.7	.8	.9	.8	.7
15		2.8	1.5	1.8	.5	.5	.7	.7	.8	.8
16		2.4	1.6	1.5	.5	.6	.6	.6	.7	.8
17		2.0	2.0	1.3	.5	.9	.6	.5	.8	.8
18		1.8	2.2	1.1	.6	.7	.8	.4	1.0	1.0
19		1.6	3.0	1.4	1.2	.6	1.7	.4	.7	.7
20		1.4	2.5	1.7	1.2	.5	1.3	.4	.7	.6
21		1.3	1.9	1.8	.9	.5	1.3	.5	.8	.6
22		3.4	1.7	1.5	.7	.4	1.1	.6	.7	.8
23		2.6	1.5	1.4	.6	.4	1.0	.6	.5	.7
24		2.1	1.3	1.2	.5	.3	1.0	.6	.6	.7
25		2.0	1.2	1.0	.7	.2	.7	.5	.6	1.0
26		1.9	1.1	.9	.5	.3	.6	.6	1.1	.8
27		2.2	1.3	1.8	.4	.3	.7	.6	1.0	.8
28		1.9	1.5	1.5	.7	.5	.5	.4	1.0	.7
29	4.0	2.1	1.3	1.2	.4	.4	.5	.4	.7	.7
30		2.0	1.2	1.0	.3	.3	.5	.4	1.0	.7
31			1.1		1.3	.3		.4		.8

NOTE.—River frozen January 1 to March 28. Ice broke up March 26 and went out March 28.

Station rating table for Carrabassett River at North Anson, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	85	1.20	675	2.20	1,585	3.20	2,710
.30	120	1.30	755	2.30	1,690	3.30	2,830
.40	160	1.40	840	2.40	1,795	3.40	2,955
.50	205	1.50	925	2.50	1,900	3.50	3,080
.60	256	1.60	1,015	2.60	2,010	3.60	3,210
.70	313	1.70	1,105	2.70	2,120	3.70	3,345
.80	376	1.80	1,295	2.80	2,235	3.80	3,480
.90	445	1.90	1,290	2.90	2,350	3.90	3,615
1.00	520	2.00	1,385	3.00	2,470	4.00	3,750
1.10	595	2.10	1,485	3.10	2,590		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1902-1905. It is well defined throughout.

Estimated monthly discharge of Carrabassett River at North Anson, Me., for 1905.

[Drainage area, 340 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	3,750	755	1,814	5.34	5.96
May	3,210	595	1,316	3.87	4.46
June	3,480	256	789	2.32	2.59
July	2,120	120	459	1.35	1.56
August	2,350	120	343	1.01	1.16
September	1,585	120	490	1.44	1.61
October	520	120	205	.602	.694
November	595	160	354	1.04	1.16
December	840	256	404	1.19	1.37

SANDY RIVER NEAR MADISON, ME.

Sandy River rises near Rangeley Lake, flowing at first southeastward, then in the last third of its course northeastward into Kennebec River, which it joins about 2 miles below the village of Madison. It has a total length of about 50 miles, and while there are a few small ponds in its basin its storage capacity is small and the flow is quite variable. It resembles very much in this way Carrabassett River, the slopes being usually steep and the fall very rapid throughout the greater part of its course. Comparatively few water-power developments have been made—namely, at New Sharon, Farmington, and at the point described below near Madison.

This station was established March 23, 1904, by F. E. Pressey. It is located at the dam of the Madison Electric Works, just over the town line in Stark, but is nearer the Madison post-office. The drainage area at this point is about 650 square miles. The dam rests on ledge rock and has a fairly level crest, 341.4 feet in length between vertical abutments. The crest is 1 foot wide on top, sloping from the upstream edge, 4.75 horizontal to 1.25 vertical, while the downstream face of the dam is vertical. The level top is of dressed stone (6-cut), while the remainder is quarry faced, but care has been taken to leave no considerable projection on the approach to the crest. Provision has been made for the installation of flashboards when necessary. The head developed by the dam is about 15 feet, which is used in a power development on the right bank, consisting of a fore-bay nearly 100 feet long, decreasing in width from 40 to 20 feet at the racks, and one pair of 36-inch McCormick turbines (rated at Holyoke), with complete arrangements for a second pair if found necessary. This plant is owned by the Madison village corporation and is used for furnishing light and power. The pondage extends back about 2 miles, but there is no side flowage. When water is more than 3 feet deep on the dam the crest is increased in length about 87.5 feet by flowing over the wall of the fore bay. The wheels and generators are in operation only during the night, so that the discharge has been based upon a gage height read late in the afternoon just before starting up; and it is believed that the pondage effect has been wholly eliminated in this way.

A plain vertical staff gage was first fastened to the retaining wall of the dam, the elevation of the 100-foot mark at the gage being equal to the elevation of the crest of the dam. This has been superseded, however, by a float gage referred to the same datum and installed through the courtesy and assistance of C. S. Humphreys, C. E., of Madison, engineer in charge. At the same time another float gage was placed to record the height of water in the tailrace, so that in case it becomes necessary to use the turbines in estimating flow, records of the head on the wheels may be obtained. The gages are referred to the following bench mark: A point inclosed by a circle on the north side of the wing wall, about 22.8 feet from its end at the dam, marked "B. M." Its elevation is 102.98 feet above gage datum. The gages are read twice daily by Marcus W. Moore, electrician at the station.

Estimated monthly discharge of Sandy River near Madison, Me.

[Drainage area, 650 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 23-31	5,335	890	2,682	4.12	1.38
April	11,265	1,757	4,858	7.47	8.33
May	10,325	516	3,580	5.51	6.35
June	1,064	66	355	.546	.609
July	516	66	234	.360	.415
August	1,871	135	322	.495	.571
September	1,101	42	273	.420	.469
October	4,309	224	654	1.01	1.16
November	675	224	410	.631	.704
December	440	170	299	.460	.530
1905.					
January	874	224	492	.757	.873
February	645	112	313	.482	.502
March	7,908	112	1,436	2.21	2.55
April	7,026	1,046	2,558	3.94	4.40
May	2,892	477	1,336	2.06	2.37
June	3,330	224	658	1.01	1.13
July	2,653	60	292	.449	.518
August	2,078	0	224	.345	.398
September	1,601	42	350	.538	.600
October	339	37	89	.137	.156
November	388	49	215	.331	.369
December	898	165	327	.503	.580
The year	7,908	0	691	1.06	14.45

NOTE.—After August 31, 1905, wheels were run during both day and night, and estimates are based on both the flow over dam and through the wheels. Gage readings and gate openings read five times daily.

MESSALONSKEE RIVER AT WATERVILLE, ME.

Messalonskee River enters the Kennebec from the west at Waterville. It has a total drainage area of 208 square miles, of which 30 square miles are lake surface. Of this lake system Messalonskee Lake is nearest to the mouth of the river. In this lower portion of the river—about 10 miles in length—there is a fall of about 210 feet, which is practically all utilized.

The United States Geological Survey has maintained a gage at the dam of the Chase Manufacturing Company, in Waterville, since June 18, 1903. The drainage area at this point is about 205 square miles. A vertical staff gage is fastened to the wheel pit just above the dam. The zero of the gage corresponds to the level of the crest of the dam and is referred to a bench mark, as follows: Copper bolt in ledge on opposite side of the river from the end of the dam; elevation, 14.51 feet above the crest of the dam. The dam is a new crib without leakage and with a good crest. Generally the water is not used for power purposes at night, and the gage is read while the wheels are not running. At other times the amount of water used through the wheels is added to that which flows over the dam. Flashboards are maintained during low stages of the river. The gage is read once a day by Ernest E. Bowie, watchman at the mill.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 56-57; 124, p 72.
Discharge, daily: 97, p 57; 124, p 73.

Mean daily discharge, in second-feet, of Messalonskee River at Waterville, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	432	395	383	697	336	212	64	90	90	.....	118
2	408	360	360	668	314	251	.....	90	90	118	149
3	432	351	336	587	292	273	.....	118	.....	.....	134
4	434	314	337	507	336	212	.....	118	118	.....	149
5	432	360	472	533	251	193	.....	118	90	.....	.....
6	383	292	457	587	314	230	.....	.....	90	.....	.....
7	395	292	533	533	212	177	.....	118	118	.....	.....
8	642	273	507	543	230	212	.....	118	64	.....	.....
9	482	301	577	577	251	177	.....	90	64	118	.....
10	432	336	587	432	301	159	.....	90	.....	118	.....
11	432	348	559	472	260	111	.....	90	90	149	.....
12	408	432	615	482	336	144	.....	90	90	149	.....
13	383	360	482	457	336	144	90	.....	118	118	.....
14	408	314	507	408	360	149	77	90	118	118	.....
15	408	336	432	383	383	111	90	90	118	.....	.....
16	383	336	383	383	383	144	.....	90	90	118	.....
17	408	360	432	408	432	177	90	90	.....	149	.....
18	422	336	383	383	408	212	90	118	90	118	.....
19	482	432	587	422	432	177	90	118	105	149	.....
20	472	360	587	383	533	212	105	.....	64	149	.....
21	432	336	533	432	314	193	90	90	69	118	.....
22	432	348	482	507	273	183	90	90	90	.....	.....
23	422	360	507	408	251	177	.....	90	90	134	.....
24	434	383	472	383	212	193	118	90	.....	149	.....
25	482	336	482	360	212	177	118	90	90	134	.....
26	472	383	995	383	251	177	90	90	118	118	.....
27	482	360	870	395	212	64	90	.....	118	149	.....
28	482	336	753	336	432	54	118	90	105	149	.....
29	422	.....	811	336	383	54	118	90	118	.....	.....
30	434	.....	753	360	251	26	.....	64	118	149	.....
31	395	.....	697	.....	314	.....	149	90	.....	149	.....

NOTE.—Twelve-inch flashboards on from June 27 to November 4, inclusive. Figures for discharge are probably unreliable after about June 1, owing to insufficient data.

COBBOSSEECONTEE RIVER AT GARDINER, ME.

Cobbosseecontee River drains a group of lakes lying from 5 to 15 miles west of Augusta, having areas aggregating 19 square miles, and empties into the Kennebec 6 miles below that city at Gardiner. Its total drainage area is about 240 square miles. From the ordinary surface of Lake Maranacook, one of the upper lakes, to mean tide at the mouth of the river the fall is 206 feet, and in the lower three-fourths of a mile it is said to be 136 feet. From above the uppermost of the eight dams controlled by the Gardiner Water Power Company, which are in the lower three-fourths of a mile, the municipal water supply for Gardiner is drawn and pumped by water power. Record is kept of the water pumped and of the water that passes the dam through a waste gate. The sum of these quantities represents the yield of the drainage area at the upper dam, records of which have been kept by the Gardiner Water Power Company for a series of years and have been furnished to the

Survey by S. D. Warren & Co., through Joseph A. Warren. The record for 1905 is presented in the accompanying table. On Sundays and legal holidays the gates are closed and no water is permitted to run, unless the lakes are full. This is a most remarkable example of the regularity of flow that can be obtained with proper storage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 82, pp 38-39; 97, pp 57-58; 124, pp 73-74.
Discharge, daily: WS 82, p 39; 97, p 58; 124, p 74.
Discharge, monthly: Ann 19, iv, pp 81-84.
Discharge, yearly: Ann 20, iv, p 46.
Hydrograph: Ann 19, iv, p 80.
Rainfall and run-off relation: Ann 19, iv, p 80.

Mean daily discharge, in second-feet, of Cobbosseecontee River at Gardiner, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	160	160	565	280	285	280	260	220	10	115	180
2	115	160	150	605	280	285	10	260	220	220	115	180
3	115	160	140	453	280	285	280	260	10	220	115	10
4	115	160	140	330	280	10	145	260	220	220	115	180
5	115	30	60	340	285	285	135	260	220	220	10	180
6	115	160	130	568	285	285	260	10	220	220	180	195
7	115	160	130	882	10	280	260	260	220	220	180	195
8	10	160	125	703	285	280	260	260	220	10	180	195
9	160	160	115	530	285	280	10	260	220	220	180	195
10	160	160	120	400	285	280	260	260	10	220	180	10
11	160	160	125	290	285	10	260	260	220	220	180	195
12	160	20	35	290	285	280	260	260	220	220	10	195
13	160	160	125	290	285	280	260	10	220	220	180	195
14	160	160	115	290	10	280	260	260	220	220	180	195
15	10	160	110	290	285	280	260	260	220	10	180	195
16	160	160	105	113	285	280	10	260	220	220	180	195
17	160	160	105	290	285	280	260	260	10	220	180	10
18	160	160	100	290	285	10	260	260	220	220	180	195
19	160	25	20	290	285	280	260	260	220	220	10	195
20	160	160	160	290	285	280	260	10	220	220	180	195
21	160	160	170	290	10	280	260	260	220	220	180	195
22	10	160	200	290	285	280	260	260	220	10	180	195
23	160	160	210	10	285	280	10	260	220	220	180	195
24	160	160	210	290	285	280	260	260	10	220	180	10
25	160	160	210	290	285	10	260	260	220	210	180	25
26	160	20	10	290	285	280	260	260	220	190	10	195
27	160	160	260	290	285	280	260	10	220	170	180	195
28	160	160	260	280	10	280	260	220	220	160	180	195
29	20	.....	286	280	285	280	260	220	220	10	180	195
30	160	.....	484	10	10	280	10	220	220	115	10	195
31	160	.....	591	.....	285	.....	260	220	.....	115	.....	10

NOTE.—Leakage of dam taken at 10 second-feet, as determined by measurements during 1905.

Estimated monthly discharge of Cobbosseecontee River at Gardiner, Me., for 1905.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	160	10	127	0.529	0.610
February	160	20	141	.588	.612
March	591	10	166	.692	.798
April	882	10	347	1.45	1.62
May	285	10	240	1.00	1.15
June	285	10	245	1.02	1.14
July	280	10	213	.888	1.02
August	260	10	223	.929	1.07
September	220	10	192	.800	.898
October	220	10	175	.729	.840
November	180	10	143	.596	.665
December	195	10	158	.658	.759
The year	882	10	198	.823	11.18

ANDROSCOGGIN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Androscoggin River is formed by the junction of Magalloway River and the outlet of the Umbagog-Rangeley lakes near the Maine-New Hampshire boundary line. For about 35 miles it flows southward into the State of New Hampshire, then turns abruptly to the east and flows into the State of Maine, then turns to the south and joins the Kennebec in Merrymeeting Bay. The last fall on the Androscoggin is at Brunswick, Me., above which place the drainage area is 3,470 square miles, about 80 per cent of this being in Maine. The greatest length of the basin is 110 miles, the greatest width 70 miles, while the river itself measures about 200 miles in length from the sources of Magalloway River to the coast. The following table gives the drainage areas of the river and of some of its chief tributaries:

Drainage areas of Androscoggin River and principal tributaries.

River.	Locality.	Drainage area.
		Sq. miles.
Androscoggin	Immediately below junction of Umbagog outlet and Magalloway River, at Errol dam.	1,090
Do	Berlin	1,350
Do	Gorham	1,375
Do	Shelburne at gaging station	1,500
Do	Rumford Falls	2,090
Do	Dixfield at gaging station	2,230
Do	Livermore Falls	2,550
Do	Lewiston Falls	2,950
Do	Brunswick	3,470
Umbagog outlet	Immediately above junction with Magalloway River	590
Magalloway	Mouth	500
Little Androscoggin	do	380

The lower part of the basin is hilly and moderately wooded, while the upper two-thirds is broken and mountainous, heavily timbered, and with a gravelly, sandy soil. Granite, gneiss, and mica-schists abound along the main course of the river, with clay slate in the upper part of the basin. The river, like others on the southern slopes of Maine, generally has a rocky bed, particularly where falls occur, has high banks and is seldom subject to overflow—all of which are features of advantage in the development of water powers. Below Berlin the facilities for rail transportation are excellent. Tide-water navigation extends to the falls at Brunswick.

ANDROSCOGGIN RIVER AT ERROL DAM, N. H.

Four large storage dams are maintained in the Umbagog-Rangeley Lake system. They are located at the outlets of Rangeley, Mooselucmaguntic, Richardson, and Umbagog lakes. Errol dam, at the outlet of Umbagog Lake, is the lowest of the series and is below the mouth of Magalloway River. The other three dams control completely the flow from the basin above Richardson Lake, aggregating 520 square miles in area. Errol dam controls in part the run-off from a total area of 1,090 square miles, which includes the area tributary to Richardson Lake mentioned above, but its height is not sufficient to store the total freshet flow.

The United States Geological Survey, cooperating with Walter H. Sawyer, agent of the Union Water Power Company, Lewiston, Me., is making a series of measurements of flow through the gates at Errol dam. A continuous record of gate openings is kept and when a sufficient number of measurements have been made to warrant the construction of a rating curve for the gates a continuous record of flow at this point will be available. The results of these measurements are not yet ready for publication.

ANDROSCOGGIN RIVER AT GORHAM, N. H.

In 1903 the Berlin Mills Company constructed a tight crib dam in Androscoggin River at Gorham. From November 27, 1903, until the end of the year estimates of discharge were obtained by means of a rectangular notch constructed in the dam, and the records furnished by H. S. Ferguson, engineer for the company. No records of flow are available for 1905 at this point. The drainage area here is 1,375 square miles.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 60; 124, p 76.
Discharge, daily: 97, p 60.

ANDROSCOGGIN RIVER AT SHELBURNE, N. H.

This station was established May 30, 1903, by N. C. Grover. It is located at the steel highway bridge about one-half mile north of the railway station at Shelburne, N. H.

The channel of the river is straight for 500 feet above and 1,000 feet below the station, is about 400 feet wide at ordinary stages, and is broken by two piers. The bed of the stream is sandy and usually permanent, but in case of serious obstructions to the channel by ice or logs noticeable changes take place. The velocity is swift at high stages, but becomes low and poorly distributed, with considerable obliquity during medium and low water conditions. The banks on both sides are subject to overflow in extreme freshets.

Discharge measurements are made at high and ordinary stages from the bridge. The initial point for soundings is on the left bank of the river at the end of the inclined end post of the downstream truss. Low-water measurements are made from

a boat at a point about 1,000 feet below the bridge, where an excellent site exists for gaging.

The gage, which is read twice each day by James Simpson, is a standard chain gage attached to the guard timber on the downstream side of the bridge. The length of the chain was 20.66 feet when the gage was established. This was changed to 20.72 feet on August 4, 1904, owing to a change in the flooring of the bridge and consequently in the position of the gage. It is referred to bench marks as follows: (1) Marked point on south edge of westernmost cylindrical pier; elevation, 17.82 feet. (2) Marked point on lower chord near gage; elevation, 18.77 feet. (3) Highest point of bowlder near easternmost pier; elevation, 7.14 feet. All elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 61; 124, p 76.
Discharge: 97, p 61; 124, p 77.
Gage heights: 97, p 62; 124, p 77.

Discharge measurements of Androscoggin River at Shelburne, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	F. E. Pressey	394	1,335	2.68	5.34	3,580
July 14	do	392	1,150	1.91	4.62	2,200
August 1	H. K. Barrows	394	1,760	3.11	6.11	5,480
August 1	do	394	1,850	3.38	6.39	6,240
August 2	Barrows and Norcross	394	1,470	2.63	5.37	3,860
August 3	T. W. Norcross	394	1,290	2.18	4.93	2,810
October 18[a]	Barrows and Norcross	384	1,050	1.58	4.34	1,660

[a] Measurement in third span made from upstream side of bridge.

Daily gage height, in feet, of Androscoggin River at Shelburne, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	.....	.....	5.1	6.1	4.8	4.8	6.55	4.7	4.3	4.3	4.6
2	.....	.....	.....	4.9	6.25	4.8	4.8	5.25	4.6	4.3	4.3	4.45
3	.....	.....	.....	4.75	6.7	4.75	4.8	4.9	4.8	4.2	4.3	4.75
4	.....	.....	.....	4.85	7.3	4.75	4.85	4.8	4.8	4.3	4.3	4.6
5	.....	6.6	6.3	4.8	7.45	4.8	4.7	4.8	4.6	4.3	4.3	4.55
6	.....	.....	.....	4.95	7.3	4.7	4.8	4.55	4.55	4.3	4.2	4.65
7	.....	.....	.....	5.05	7.25	4.7	4.8	4.65	4.5	4.25	4.3	4.6
8	6.05	.....	.....	5.1	7.2	4.6	4.8	4.55	4.4	4.3	4.3	4.45
9	.....	.....	.....	5.05	7.2	4.6	4.8	4.6	4.4	4.3	4.3	4.3
10	.....	.....	.....	5.3	7.2	4.6	4.9	4.5	4.3	4.3	4.3	4.2
11	.....	.....	.....	5.7	7.15	4.5	4.8	4.5	4.4	4.4	4.3	5.7
12	.....	6.5	5.2	5.6	7.0	4.5	4.75	4.5	4.4	4.8	4.1	7.35
13	.....	.....	.....	5.7	6.9	4.55	4.75	3.8	4.5	4.65	4.2	.....
14	.....	.....	.....	5.55	6.9	5.6	4.6	4.5	4.5	4.5	4.1	.....
15	6.7	.....	.....	4.95	6.7	5.45	4.5	4.6	4.4	5.0	4.1	.....
16	.....	.....	.....	4.7	6.6	5.35	4.3	4.95	4.5	4.5	4.15	.....
17	.....	.....	.....	4.65	6.4	5.05	4.4	4.95	4.5	4.15	4.2	7.1
18	.....	.....	.....	4.8	6.2	4.9	4.5	4.8	4.9	4.1	4.2	.....
19	.....	6.4	6.6	4.7	6.1	4.8	4.5	4.55	4.8	4.25	4.2	.....
20	.....	.....	.....	4.8	5.9	4.7	4.4	4.35	4.5	4.1	4.2	.....
21	.....	.....	.....	5.0	5.9	4.6	4.4	4.4	4.5	4.1	4.2	.....
22	6.4	.....	.....	5.15	5.7	4.8	4.4	4.4	4.45	4.15	4.25	.....
23	.....	.....	.....	5.0	5.7	4.85	3.65	4.4	4.4	4.35	4.2	.....
24	.....	.....	.....	5.1	5.4	4.9	4.4	4.35	4.35	4.2	4.3	7.2
25	.....	.....	.....	5.45	5.15	4.9	4.4	4.4	4.5	4.25	4.3	.....
26	.....	6.7	7.8	5.7	5.15	5.05	4.2	4.4	4.5	4.2	4.2	.....
27	.....	.....	.....	5.6	5.0	5.3	4.2	4.4	4.4	4.3	4.3	.....
28	.....	.....	.....	5.85	5.0	5.15	4.2	4.5	4.4	4.3	4.2	.....
29	5.7	.....	7.2	5.95	4.9	5.05	4.25	4.4	4.45	4.25	4.25	.....
30	.....	.....	6.1	6.15	4.95	4.9	4.0	4.55	4.4	4.4	4.25	.....
31	.....	.....	6.1	.....	4.9	.....	7.95	4.8	.....	4.35	.....	6.3

NOTE.—River frozen January 1 to March 30 and December 13–31, also ice conditions December 1–12. During the frozen period gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	6.7	7.1	1.9
January 8	6.05	6.45	1.7
January 15	6.7	6.9	2.1
January 22	6.4	6.8	2.1
January 29	5.7	6.5	2.5
February 5	6.6	6.9	3.1
February 12	6.5	6.7	3.2
February 19	6.4	6.7	3.0
February 26	6.7	6.9	3.1
March 5	6.3	6.6	3.2
March 12	5.2	6.3	2.9
March 19	6.6	6.8	2.7
March 26	7.8	7.8	2.5
December 17	7.1	7.25	.7
December 24	7.2	7.35	.6
December 31	6.3	6.4	.5

March 29, water flowing on top of ice; ice jam below gage. March 30, river clear. December 11–12, anchor ice caused rise.

Station rating table for Androscoggin River at Shelburne, N. H., from May 30, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	1,100	4.90	2,680	5.90	4,970	6.90	7,660
4.00	1,212	5.00	2,890	6.00	5,225	7.00	7,950
4.10	1,336	5.10	3,105	6.10	5,480	7.20	8,530
4.20	1,472	5.20	3,325	6.20	5,740	7.40	9,130
4.30	1,618	5.30	3,545	6.30	6,000	7.60	9,730
4.40	1,774	5.40	3,775	6.40	6,265	7.80	10,330
4.50	1,938	5.50	4,005	6.50	6,535	8.00	10,930
4.60	2,110	5.60	4,240	6.60	6,810	8.20	11,550
4.70	2,290	5.70	4,480	6.70	7,090	8.40	12,170
4.80	2,480	5.80	4,725	6.80	7,375	8.60	12,790

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1903–1905. It is well defined between gage heights 4.3 feet and 7.7 feet, and somewhat uncertain below 4.3 feet.

Estimated monthly discharge of Androscoggin River at Shelburne, N. H., for 1903–1905.

[Drainage area, 1,500 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
June	12,020	1,049	2,800	1.87	2.09
July	2,480	1,156	1,775	1.18	1.36
August	1,774	1,404	1,610	1.07	1.23
September	1,618	1,472	1,547	1.03	1.15
October	1,938	1,472	1,669	1.11	1.28
November	1,774	1,618	1,626	1.08	1.20
1904.					
April 9–30	8,095	1,774	3,563	2.37	1.94
May	12,790	3,105	8,334	5.56	6.41
June	3,105	1,938	2,426	1.62	1.81
July	3,325	1,156	2,026	1.35	1.56
August	1,774	1,212	1,426	.951	1.10
September	1,938	1,618	1,813	1.21	1.35
October	3,105	1,696	2,112	1.41	1.63
November	2,480	1,336	1,651	1.10	1.23
1905.					
April	5,610	2,200	3,359	2.24	2.50
May	9,280	2,680	5,991	3.99	4.60
June	4,240	1,938	2,641	1.76	1.96
July	10,780	862	2,296	1.53	1.76
August	6,672	998	2,235	1.49	1.72
September	2,680	1,618	1,970	1.31	1.46
October	2,890	1,336	1,677	1.12	1.29
November	1,618	1,336	1,527	1.02	1.14

NOTE.—River frozen November 28 to December 31, 1903; January 1 to April 9 and December 3–31, 1904; January 1 to March 30 and December 1–31, 1905. Estimates November 28–30, 1903, corrected to allow for influence of ice.

ANDROSCOGGIN RIVER AT RUMFORD FALLS, ME.

One of the finest water powers on the Atlantic coast drainage is at Rumford Falls. Here the Androscoggin descends 177 feet in 1 mile in several pitches over granite ledges. A comprehensive plan of development has been laid out and partly executed. It contemplates the use of power from three levels—a high-level canal, with a fall of 97 feet to the middle level, which receives also a direct and independent supply of water from the river. The water in the middle-level canal is then used and discharged after a fall of 50 feet into the low level, from which, in turn, there is a final drop of 30 feet to the river. Dams have been built at the entrance of the high and middle level canals. At present about 19,000 horsepower are utilized, largely in the manufacture of pulp and paper. An economical development of the entire fall of 177 feet would furnish 50,000 horsepower. This power is 85 miles by rail from Portland, and for pulp and paper manufacture has the advantage of excellent transportation facilities. Androscoggin River is used for floating pulp wood and timber from the headwaters down to the mills, and the Rumford Falls and Rangeley Lakes Railroad makes available the remoter resources of spruce, poplar, and birch.

The discharge of Androscoggin River at Rumford Falls since 1892 has been computed by Charles A. Mixer, resident engineer of the Rumford Falls Power Company. These statistics are obtained by adding the actual measured quantities passing through the wheels to the computed flow over the dam, using the customary Francis weir formula with modified coefficient.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: Ann 20, iv, p 66; WS 27, p 9; 35, p 27; 47, pp 31–32; 65, p 20; 82, p 42; 97, pp 62–63; 124, p 78.
Discharge, daily: Ann 20, iv, pp 67–69; WS 27, pp 14–16; 35, p 28; 47, p 32; 65, p 21; 82, p 43; 97, p 63.
Discharge, monthly: Ann 19, iv, pp 93–94; 20, iv, p 70; 21, iv, p 57; 22, iv, p 60; WS 75, p 22; 82, p 43.
Discharge, yearly: Ann 20, iv, pp 46, 71.
Hydrographs: Ann 19, iv, pp 94, 95; 20, iv, p 67; 21, iv, p 57; 22, iv, p 61.
Rainfall and run-off relation: Ann 19, iv, pp 96–97.
Rainfall data: Ann 21, iv, p 57.
Water powers: Ann 19, iv, pp 90–91.

Daily discharge, in second-feet, of Androscoggin River at Rumford Falls, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,027	1,720	1,500	10,288	6,486	2,889	2,904	14,784	2,492	1,755	1,855	1,665
2	2,032	1,715	1,442	6,230	5,843	2,875	3,164	6,203	2,078	1,699	1,910	2,033
3	2,134	1,697	1,398	4,988	5,867	2,791	5,049	3,882	2,523	1,863	1,855	2,511
4	1,932	1,702	1,404	4,910	8,245	2,369	4,403	3,207	6,254	1,838	1,958	3,909
5	1,709	1,659	1,366	4,182	8,435	2,631	3,963	2,804	4,785	1,696	1,897	2,648
6	1,752	1,527	1,257	5,194	7,639	2,813	3,254	2,550	3,445	1,631	2,167	2,535
7	1,793	1,709	1,318	6,217	8,651	2,939	3,107	2,385	2,976	1,614	2,165	2,636
8	1,906	1,616	1,229	4,885	8,127	2,727	2,759	2,840	2,629	1,470	2,194	2,435
9	1,982	1,546	1,210	4,127	7,924	2,531	2,512	3,085	2,389	1,599	2,095	2,344
10	2,115	1,532	1,201	4,291	8,110	2,257	2,719	2,832	2,164	1,634	2,151	2,004
11	2,100	1,570	1,220	5,994	7,924	2,093	2,716	2,454	1,947	1,709	2,064	1,534
12	2,087	1,420	1,213	5,807	7,729	2,801	2,800	2,307	1,979	2,447	2,001	1,762
13	2,009	1,490	1,037	5,799	6,817	4,412	3,034	2,059	2,596	3,081	2,098	1,816
14	2,002	1,663	1,265	5,938	5,928	5,412	2,807	2,172	2,415	2,586	2,103	2,007
15	1,918	1,546	1,124	5,845	5,528	4,180	2,195	2,231	2,104	2,310	1,686	1,785
16	1,849	1,512	1,062	5,121	5,426	3,589	2,036	3,068	2,001	2,251	2,097	1,711
17	2,016	1,494	1,045	4,504	5,139	3,448	2,135	4,036	1,865	2,152	2,245	1,734
18	1,917	1,516	1,067	3,857	4,966	3,277	2,185	2,989	3,321	2,127	1,838	1,721
19	1,931	1,481	1,330	3,582	5,313	3,389	1,927	2,584	4,767	2,177	1,710	1,890
20	1,905	1,389	2,375	3,468	4,696	3,310	1,889	2,091	3,508	2,328	1,776	1,899
21	1,960	1,629	2,020	4,853	4,955	3,012	1,910	1,986	3,311	2,334	1,794	1,870
22	1,861	1,550	1,754	9,087	4,415	3,010	1,747	1,941	3,062	2,089	1,992	1,795
23	1,865	1,578	1,665	7,070	3,838	3,000	1,544	1,772	2,865	2,083	1,974	1,925
24	1,909	1,575	1,693	5,649	3,647	2,808	1,167	1,799	2,413	2,087	2,012	1,989
25	1,844	1,585	3,145	4,615	3,606	2,535	1,660	1,799	2,421	2,034	2,270	1,790
26	1,792	1,527	7,139	4,636	3,482	3,648	1,689	1,743	2,392	1,990	2,502	1,744
27	1,726	1,460	7,135	4,600	3,786	6,541	1,540	1,975	2,239	1,978	2,548	1,870
28	1,761	1,596	7,445	4,605	3,815	4,652	1,492	2,703	2,339	1,964	1,775	1,796
29	1,791	.....	8,171	4,683	3,519	3,712	1,480	2,285	2,097	1,950	2,340	1,798
30	1,674	.....	9,295	5,470	3,325	2,915	1,747	1,988	1,979	1,861	2,664	1,934
31	1,803	.....	12,398	.....	3,099	.....	17,523	2,156	.....	1,921	.....	1,998

Estimated monthly discharge of Androscoggin River at Rumford Falls, Me., for 1905.

[Drainage area, 2,090 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,134	1,674	1,907	0.912	1.05
February	1,720	1,389	1,572	.752	.783
March	12,390	1,037	2,836	1.36	1.57
April	10,290	3,468	5,350	2.56	2.86
May	8,651	3,099	5,685	2.72	3.14
June	6,541	2,093	3,286	1.57	1.75
July	17,520	1,167	2,937	1.41	1.63
August	14,780	1,743	2,990	1.43	1.65
September	6,254	1,865	2,777	1.33	1.48
October	3,081	1,470	2,008	.961	1.11
November	2,664	1,686	2,058	.985	1.10
December	3,909	1,534	2,035	.974	1.12
The year	17,520	1,037	2,953	1.41	19.24

ANDROSCOGGIN RIVER AT DIXFIELD, ME.

This station was established August 22, 1902, by F. E. Pressey. It is located about one-half mile west of Dixfield, at the highway bridge on the road to West Peru.

The channel is straight for 1,000 feet above and one-half mile below the station and is about 600 feet wide, broken by three piers. The banks are high and not liable to overflow. The bed of the stream is rocky in the left half and sandy in the right half. The velocity is medium at high stages, but is poorly distributed at low water when the current is sluggish in the right half.

Discharge measurements are made from the bridge at high and ordinary stages. The initial point for soundings is the lower end of the inclined end post of the downstream truss on the left bank. Low-water measurements are made from the bridge for only the two left-hand portions of the channel, while the remaining part is gaged by wading at a point about 250 feet downstream, this being made possible by a sandy bar separating these two parts.

A standard chain gage, which is read twice each day by S. F. Robinson, is fastened to the guard timber on the lower side of the bridge. The length of the chain is 31.76 feet. It is referred to bench marks as follows: (1) Southeast corner of bridge seat on north abutment; elevation, 24.77 feet. (2) Copper bolt in ledge under east end of bridge; elevation, 11.53 feet. (3) Top of short post at west hanger in east span; elevation, 33.15 feet when gage was established; found to be 33.08 feet August 3, 1904, probably due to settling of the post. All elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 41; 97, p 64; 124, pp 78-79.
Discharge: 82, p 41; 97, p 64; 124, p 79.
Discharge, monthly: 97, p 66.
Gage heights: 82, p 41; 97, p 65; 124, p 79.
Rating table: 97, p 65.

Discharge measurements of Androscoggin River at Dixfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 25	F. E. Pressey	485	2,860	2.39	9.42	6,840
August 17	do	478	2,770	1.94	9.24	5,390
August 18	do	479	2,490	1.49	8.72	3,710
September 13	do	471	2,250	1.14	8.25	2,560
September 14	do	466	2,290	1.16	8.31	2,660
September 15	do	457	2,160	1.07	8.14	2,310
October 27[a]	H. K. Barrows	384	1,290	1.60	7.94	2,060

[a] Wading in two channels.

Daily gage height, in feet, of Androscoggin River at Dixfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				11.6	9.9	8.55	8.6	12.95	8.25	7.9	8.0	8.15
2				10.2	9.9	8.55	8.6	10.55	8.1	7.75	7.95	8.4
3		9.9		9.65	9.7	8.45	9.35	9.2	8.05	8.0	7.95	8.35
4			9.4	9.55	10.25	8.4	9.3	8.75	9.9	7.9	7.95	9.0
5				9.3	10.55	8.4	8.95	8.55	9.25	7.9	8.1	9.05
6	9.7	9.9		9.4	10.25	8.5	8.8	8.4	8.95	7.8	7.95	8.5
7				10.1	10.45	8.75	8.7	8.3	8.65	7.7	8.15	8.5
8	9.9			9.6	10.55	8.4	8.45	8.45	8.45	7.75	8.1	8.45
9				9.25	10.35	8.35	8.35	8.6	8.3	7.85	8.1	8.3
10		9.9	9.0	9.25	10.3	8.2	8.3	8.55	8.1	7.85	8.1	8.15
11			9.0	9.85	10.25	8.35	8.35	8.3	7.95	7.85	8.05	8.1
12	9.6		8.85	9.8	10.15	8.5	8.4	8.2	8.05	8.05	8.0	8.1
13		9.8	9.05	9.85	10.0	9.25	8.55	8.1	8.25	8.85	8.1	8.15
14			8.85	9.85	9.7	9.45	8.55	8.15	8.3	8.45	8.15	8.1
15			8.7	9.85	9.55	9.2	8.25	8.2	8.1	8.15	7.8	8.1
16			7.8	9.6	9.55	8.9	7.95	8.3	8.0	8.1	7.95	9.0
17	9.8		7.6	9.4	9.55	8.7	8.05	9.15	8.0	8.15	8.25	
18			7.55	9.1	9.5	8.7	8.2	8.65	8.4	8.0	8.2	
19		9.8	7.55	8.85	9.75	8.65	8.05	8.35	9.65	8.0	7.9	
20			8.55	8.85	9.35	8.7	8.0	8.05	9.0	8.15	8.0	
21	10.1		8.6	9.15	9.55	8.65	8.0	7.95	8.9	8.15	8.1	
22	10.1		8.1	10.6	9.25	8.7	7.95	7.95	8.75	8.2	8.0	8.1
23			8.15	10.15	9.1	8.6	7.75	7.85	8.45	8.1	8.0	8.1
24		9.8	8.1	9.65	8.9	8.55	7.55	7.9	8.15	8.05	8.0	8.1
25			8.6	9.4	8.9	8.4	7.75	7.85	8.1	8.0	8.15	8.1
26		9.8	10.85	9.35	8.9	8.45	7.9	7.8	8.2	8.0	8.45	8.1
27			11.25	9.5	8.95	9.95	7.8	7.8	8.15	8.0	8.35	8.7
28	10.0		10.85	9.5	9.1	9.55	7.7	8.35	8.15	8.0	8.3	8.15
29			10.75	9.5	8.85	9.05	7.7	8.3	8.15	7.95	7.9	8.2
30			10.9	9.6	8.9	8.75	7.75	8.05	8.0	7.9	8.3	8.2
31	10.0		11.45		8.7		10.45	8.0		8.0		8.2

NOTE.—River frozen January 1 to March 10, when it was open at the gage, and clear of ice March 30. Anchor ice during the first part of December. River frozen December 15–22, and open at gage December 22–31. During frozen season gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 6, 8, 12			1.3
January 17, 21			1.4
January 22	10.1	10.2	1.4
January 28	10.0	10.2	1.5
January 31	10.0	10.2	1.6
February 3, 6	9.9	10.1	1.8
February 10	9.9	10.2	1.8
February 13	9.8	10.3	1.9
February 19	9.8	10.1	1.8
February 24, 26	9.8	10.0	1.8
March 4	9.4	9.5	1.8

Station rating table for Androscoggin River at Dixfield, Me., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.30	1,080	8.50	3,150	9.70	7,080	10.90	12,310
7.40	1,200	8.60	3,410	9.80	7,470	11.00	12,800
7.50	1,330	8.70	3,680	9.90	7,870	11.20	13,810
7.60	1,470	8.80	3,970	10.00	8,280	11.40	14,840
7.70	1,620	8.90	4,270	10.10	8,700	11.60	15,880
7.80	1,770	9.00	4,580	10.20	9,130	11.80	16,940
7.90	1,930	9.10	4,900	10.30	9,560	12.00	18,000
8.00	2,100	9.20	5,230	10.40	10,000	12.20	19,060
8.10	2,280	9.30	5,580	10.50	10,450	12.40	20,130
8.20	2,480	9.40	5,940	10.60	10,900	12.60	21,210
8.30	2,690	9.50	6,310	10.70	11,360	12.80	22,300
8.40	2,910	9.60	6,690	10.80	11,830	13.00	23,400

NOTE.—The above table is applicable only for open channel conditions. It is based on nine discharge measurements made during 1903–1905. It is fairly well defined.

Estimated monthly discharge of Androscoggin River near Dixfield, Me., for 1904–5.

[Drainage area, 2,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 26–31	19,320	3,970	10,160	4.56	1.02
April	27,000	3,150	8,210	3.68	4.11
May	23,120	4,120	13,520	6.06	6.99
June	4,425	3,030	3,584	1.61	1.80
July	4,425	1,265	2,461	1.10	1.27
August	4,740	1,330	1,792	.804	.927
September	5,065	1,080	1,911	.857	.956
October	13,050	1,545	2,962	1.33	1.53
November	2,585	1,695	2,014	.903	1.01
December 1–10	8,280	1,545	2,986	1.34	.498
1905.					
March (10–31)	15,100	1,400	5,732	2.57	2.10
April	15,880	4,120	6,971	3.13	3.49
May	10,680	3,680	6,965	3.12	3.60
June	8,075	2,480	3,838	1.72	1.92
July	10,220	1,400	2,979	1.34	1.54
August	23,120	1,770	3,646	1.63	1.88
September	7,870	2,015	3,138	1.41	1.57
October	4,120	1,620	2,160	.969	1.12
November	3,030	1,770	2,253	1.01	1.13
December 1–15, 22–31	4,740	2,280	2,728	1.22	1.13

NOTE.—River frozen January 1 to March 26 and December 11–31, 1904. Estimates for March and December, 1905, liable to some error, owing to ice conditions on the river. (See note to gage-height table, p. 83.)

PRESUMPSCOT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Presumpscot River is one of the most interesting as well one of the best water-power streams of its size in the United States. It is the outlet of Sebago Lake, which lies about 17 miles northwest of Portland. The lake is fed by Crooked River, a stream heading 35 miles farther north and within 3 miles of the Androscoggin. The area of the lake is 46 square miles; the total water surface on the drainage basin is 97 square miles; the area of the drainage basin at the outlet of the lake is 420 square miles, and at the mouth of the river 600 square miles. The northern part of the basin is mountainous and wooded; the southern part is moderately hilly and cleared of trees. Granite, gneiss, and mica schists appear at many points, and the soil is gravelly and sandy.

According to the survey made by Joseph A. Warren, of Cumberland Mills, the fall from the crest of the stone dam at the foot of Sebago Lake to mean low tide at the foot of the lower falls is 265.16 feet in a distance of 21.65 miles, or an average of 12.25 feet per mile.

During the past few years several new developments have been made along the river, so that the only portion now unimproved is the fall of 56 feet between Great Falls and Gambo Falls.

The tributaries of Presumpscot River are not of much importance, but some of them are outlets of ponds and have considerable fall, thus affording constant though small power. Crooked River, the chief feeder of Sebago Lake, has a number of falls, some of which are utilized.

The chief interest attaching to the river is its regularity of flow, which is due to dams at the outlet of the lake. Nowhere in the United States is there a better example of the success of storage of water and regulation of the flow of a stream than on the Presumpscot.

PRESUMPSCOT RIVER AT OUTLET OF SEBAGO LAKE, MAINE.

Since January, 1887, the flow from Sebago Lake has been regularly recorded, the quantity being deduced during most of this time from the openings in the gates at the dam, the discharging capacity of which under different conditions of head has been determined and tabulated by Hiram F. Mills, of Lowell. In March, 1904, Messrs. S. D. Warren & Co. completed a hydro-electric plant at Eel Weir Falls, near Sebago Lake, bringing water directly from the dam at the lake by means of a canal. A head of 40 feet is thus obtained at average lake level.

The development at Eel Weir has necessitated a different method of recording the flow from the lake. The water is used through three pairs of 33-inch Hercules wheels. The water used by these wheels is recorded by three Allen meters, one on each pair. These meters were rated by the result of a test at Holyoke of one pair of these wheels.

Since the station was finished the performance of the wheels and of the recording meters has been checked by careful current-meter readings in the canal and brake tests of the wheels, combined with electrical readings of the generator output. The records of the generator output of the station are kept and the constant ratio between these readings and the Allen meter records gives a good check on the latter.

It is usually desired to keep a constant flow through the canal, and when the demands for power are not sufficient to utilize the entire flow through the wheels the excess of water is run off through a pair of regulating gates at the power station, a record of the openings of these gates being kept and the flow computed from a coefficient determined by current-meter tests.

The flow at times from the lake may be greater than it is safe to carry through the canal, though this has not as yet happened. At such times it will be necessary to draw part of the water through the old regulating gates in the main dam.

A continuous record of the Sebago Lake level has been kept since January, 1872. The lake fills rapidly after March 1, attaining its maximum height between the middle of April and June 1, and then gradually subsides as water is withdrawn for mill purposes, until a minimum stage is reached—sometimes in the autumn, but usually in the winter.

The records of lake level and discharge make an unusually complete and valuable series of data. These have been furnished from time to time by S. D. Warren & Co., and the data regarding the new methods of measurement, etc., is from a description furnished by Joseph A. Warren.

The records of flow from 1887 to 1901, inclusive, are assembled in Water-Supply Paper No. 69, and those for succeeding years may be found in Water-Supply Papers Nos. 82, 97, and 124.

Mean daily discharge, in second-feet, of Presumpscot River at outlet of Sebago Lake, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	473	536	357	430	518	500	468	467	465	363	390	385
2	511	488	351	267	522	503	400	482	472	470	448	397
3	497	470	347	498	518	500	528	477	368	477	410	335
4	490	467	350	557	517	360	427	450	468	470	400	410
5	503	397	323	552	515	492	502	470	477	463	333	420
6	497	432	340	448	517	505	507	358	460	468	428	410
7	504	437	338	430	445	510	508	470	475	460	450	412
8	448	427	333	475	512	513	502	460	472	425	430	405
9	496	420	342	312	522	505	347	465	460	468	427	427
10	500	420	335	517	500	482	487	467	454	478	432	237
11	497	410	330	505	502	385	470	473	483	467	422	382
12	506	400	332	457	498	505	467	475	473	477	320	397
13	500	442	335	445	492	515	473	410	480	477	418	397
14	450	427	330	510	450	517	478	470	475	473	427	392
15	345	407	338	485	457	515	477	475	477	462	418	395
16	559	408	330	360	508	517	365	472	442	453	433	382
17	508	408	328	500	525	510	469	470	405	477	430	367
18	505	395	322	500	512	382	473	472	477	497	425	385
19	495	395	327	485	510	512	474	447	478	455	417	382
20	498	377	332	490	493	493	471	457	480	458	413	407
21	483	388	333	492	397	512	473	473	480	472	410	400
22	438	375	335	502	503	500	472	473	476	372	400	403
23	517	375	330	368	497	507	304	477	464	460	403	405
24	487	370	330	485	498	505	475	468	409	463	395	333
25	486	357	330	467	512	365	462	475	471	460	397	397
26	493	365	247	517	497	508	467	470	470	455	280	396
27	482	369	363	502	483	520	457	387	472	457	410	396
28	482	357	370	513	215	488	468	465	472	453	412	396
29	431	.....	400	505	573	510	463	469	470	428	412	395
30	494	.....	421	347	480	503	375	462	463	443	408	400
31	470	.....	451	.....	508	.....	490	477	.....	422	.....	278

Estimated monthly discharge of Presumpscot River at Outlet of Sebago Lake, Me., for 1905.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	559	345	485	1.15	1.38
February	536	357	411	.979	1.02
March	451	247	343	.817	.942
April	557	267	464	1.10	1.23
May	573	215	490	1.17	1.35
June	520	360	488	1.16	1.29
July	528	304	458	1.09	1.26
August	482	358	461	1.10	1.27
September	483	368	463	1.10	1.23
October	497	363	456	1.09	1.26
November	450	280	407	.969	1.08
December	420	237	385	.917	1.06
The year	559	215	443	1.05	14.32

SACO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Saco River receives its headwaters from the valleys and slopes of the White Mountains, at elevations of 4,000 to 5,000 feet. It drains an area of 1,720 square miles, of which 900 square miles lie in New Hampshire and the remainder in Maine. The slopes at the headwaters are very steep, with no lake storage. In the lower river are many good water powers, part of which are in use. The upper portions of the basin are generally in forest, but much of the large growth has been cut, and over large areas the evergreen trees have been entirely removed. In the lower basin are many farms and villages The underlying rock is generally granite, appearing at the surface in many mountain summits.

SACO RIVER NEAR CENTER CONWAY, N. H.

This station was established August 26, 1903, by N. C. Grover. It is located at the wooden highway bridge between Center Conway and Redstone, N. H., about 2 miles from each place.

The channel is straight for 2,000 feet above and 300 feet below the station, and is about 200 feet wide at ordinary stages, broken by one pier. The banks are high and are not liable to overflow, except in very extreme freshets. The bed is of sand and gravel, and is permanent. The current is medium at high and sluggish at low stages.

Discharge measurements are usually made by wading about 400 feet above the bridge.

A standard chain gage, which is read twice each day by Albert P. Davidson, is fastened to the floor of the bridge. The length of the chain was 30.44 feet when established, but changed to 30.47 feet August 26, 1905, on account of movement of the bridge. The gage is referred to bench marks as follows: (1) Marked point on lower chord of bridge near gage; elevation, 27.72 feet when established, but changed to 27.76 feet August 26, 1905. (2) South end of top of west abutment; elevation, 25.14 feet. Elevations refer to datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 69; 124, p 82.
Discharge: 97, p 69; 124, p 82.
Discharge, monthly: 124, p 84.
Gage heights: 97, p 69; 124, p 83.
Rating table; 124, p 84.

Discharge measurements of Saco River near Center Conway, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 6	T. W. Norcross	228	786	1.91	5.71	1,500
July 5 [a]	Murphy and Barrows	160	517	1.44	4.53	742
August 26 [b]	T. W. Norcross	136	177	1.49	3.69	263

[a] Right channel, by wading a short distance below bridge.
[b] By wading 250 feet below gage; meter on rod.

Daily gage height, in feet, of Saco River near Center Conway, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	.....	.....	7.65	6.3	4.45	4.35	8.5	4.85	4.25	4.2	6.0
2	.....	.....	.....	6.5	5.75	4.45	4.35	6.4	4.45	4.2	4.2	.....
3	.....	.....	.....	6.1	5.55	4.45	5.85	5.8	7.7	4.15	4.2	7.05
4	.....	.....	.....	6.0	6.15	4.2	4.75	5.35	9.4	4.15	4.2	7.15
5	.....	4.9	4.8	5.75	6.15	4.25	4.5	4.7	7.5	4.1	4.3	6.9
6	.....	.....	.....	6.55	5.9	4.85	4.35	4.65	5.8	4.1	4.3	6.15
7	.....	.....	.....	7.05	6.4	4.95	4.25	4.55	5.8	3.95	4.3	5.7
8	5.05	.....	.....	6.35	6.0	4.6	4.05	4.45	5.5	3.95	4.4	5.15
9	.....	.....	.....	5.95	5.7	4.4	4.0	4.55	5.2	3.85	4.45	4.85
10	.....	.....	.....	6.0	5.7	4.4	3.95	4.35	4.95	3.85	4.4	4.65
11	.....	.....	.....	6.75	5.35	4.15	4.0	4.15	4.8	3.9	4.4	4.9
12	.....	4.95	4.85	6.65	5.2	4.25	3.9	4.1	5.1	6.1	4.15	5.3
13	.....	.....	.....	6.55	5.4	6.85	3.95	4.05	6.25	5.8	4.2	5.1
14	.....	.....	.....	6.4	4.9	5.85	3.8	4.05	5.6	5.0	4.5	5.05
15	4.5	.....	.....	6.45	4.95	5.35	3.85	4.0	5.05	4.65	4.35	.....
16	.....	.....	.....	6.25	5.6	4.55	3.75	4.55	4.85	4.5	4.4	.....
17	.....	.....	.....	5.75	5.35	4.45	3.7	5.3	4.75	4.5	4.3	.....
18	.....	.....	.....	5.55	5.55	4.35	3.8	4.5	6.15	4.6	4.3	.....
19	.....	5.05	5.0	5.35	5.6	4.25	3.7	4.25	7.2	4.9	3.95	.....
20	.....	.....	7.45	5.35	5.4	4.3	3.85	4.1	6.05	4.9	4.2	.....
21	.....	.....	6.65	6.0	5.0	4.25	3.85	3.95	5.65	4.7	4.2	.....
22	5.05	.....	6.1	7.75	4.95	4.45	3.7	3.85	5.4	4.45	4.1	.....
23	.....	.....	.....	6.8	4.85	4.4	3.6	3.8	5.25	4.45	4.1	.....
24	.....	.....	.....	6.05	4.7	4.2	3.55	3.75	4.9	4.35	4.15	.....
25	.....	.....	.....	6.25	4.6	4.0	3.55	3.8	4.75	4.3	4.25	.....
26	.....	5.05	11.15	5.9	4.5	4.1	3.55	3.7	5.2	4.2	4.5	.....
27	.....	.....	8.1	6.3	4.5	6.5	3.55	3.95	5.0	4.2	4.25	.....
28	.....	.....	7.75	6.3	4.45	5.8	3.55	3.85	4.45	4.2	4.3	.....
29	4.9	.....	7.45	6.4	4.3	4.55	3.55	3.9	4.25	4.2	4.45	.....
30	.....	.....	8.0	6.3	4.3	4.55	3.6	3.95	4.25	4.2	5.9	.....
31	.....	.....	8.05	.....	4.3	.....	12.55	4.8	.....	4.2	.....	4.95

Daily gage height, in feet, of Saco River near Center Conway, N. H., for 1905—Cont'd.

NOTE.—River frozen January 1 to March 26 and December 15–31. During frozen season gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	4.5	4.55	1.2
January 8	5.05	(a)	.....
January 15	4.5	5.15	2.1
January 22	5.05	5.2	2.0
January 29	4.9	5.05	2.0
February 5	4.9	4.95	2.2
February 12	4.95	4.9	2.2
February 19	5.05	5.35	2.35
February 26	5.05	5.3	2.4
March 5	4.8	4.85	2.45
March 12	4.85	5.0	2.5

a Below water surface.

March 19, unsafe; gage height read to top of ice; March 20–22, water flowing over surface of ice; March 26, ice breaking up; March 27, river clear of ice; December 2, ice under gage 2 inches thick, but river not frozen across; December 24, gage height to top of ice, 5.1 feet; December 31, gage height to top of ice, 5.05 feet; thickness of ice, 0.95 foot at gage, but river not frozen across in left span.

Station rating table for Saco River near Center Conway, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.50	197	4.90	917	6.30	2,050	7.70	3,695
3.60	234	5.00	984	6.40	2,150	7.80	3,835
3.70	273	5.10	1,053	6.50	2,250	7.90	3,975
3.80	314	5.20	1,124	6.60	2,355	8.00	4,120
3.90	358	5.30	1,197	6.70	2,460	8.10	4,270
4.00	404	5.40	1,272	6.80	2,570	8.20	4,425
4.10	453	5.50	1,349	6.90	2,680	8.30	4,580
4.20	504	5.60	1,428	7.00	2,795	8.40	4,740
4.30	557	5.70	1,509	7.10	2,910	8.50	4,900
4.40	612	5.80	1,592	7.20	3,030	8.60	5,060
4.50	669	5.90	1,677	7.30	3,155	8.70	5,225
4.60	728	6.00	1,764	7.40	3,285	8.80	5,395
4.70	789	6.10	1,855	7.50	3,420	8.90	5,565
4.80	852	6.20	1,950	7.60	3,555	9.00	5,735

NOTE.—The above table is applicable only for open-channel conditions. It is based on fourteen discharge measurements made during 1903–1905. It is well defined between gage heights 3.4 feet and 9 feet.

Discharge measurements of Merrimac River at Franklin Junction, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 5	F. E. Pressey	231	1,350	4.00	6.69	5,400
April 11	T. W. Norcross	231	1,370	4.61	7.19	6,320
May 2	do	226	1,100	2.77	5.76	3,040
May 24	do	220	941	2.24	4.98	2,110
July 3	Murphy and Barrows	234	1,440	4.36	7.38	6,280
August 22	T. W. Norcross	216	713	1.61	4.23	1,150

Daily gage height, in feet, of Merrimac River at Franklin Junction, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	.....	.....	12.1	6.2	4.6	5.0	6.6	6.0	4.85	4.5	5.3
2	4.1	.....	.....	8.6	5.9	4.5	.....	5.6	6.0	4.9	4.4	4.9
3	4.2	.....	.....	7.4	5.7	4.6	7.15	5.05	5.45	4.7	4.4	7.9
4	4.2	.....	.....	7.1	5.7	4.25	6.15	4.75	11.05	4.7	4.65	8.55
5	4.35	.....	.....	6.7	6.0	4.6	5.55	4.6	8.8	4.65	4.7	6.7
6	4.45	.....	.....	7.4	5.8	4.65	5.1	4.0	7.4	4.55	4.8	5.6
7	5.1	.....	.....	9.1	6.3	5.65	4.9	4.35	6.3	4.5	5.1	5.7
8	5.2	.....	.....	7.55	6.8	5.25	4.8	4.2	5.85	4.1	5.15	5.25
9	5.5	.....	.....	.....	6.0	5.0	4.25	4.2	5.5	4.7	5.1	5.3
10	5.7	.....	4.25	6.7	5.9	4.75	4.6	4.3	4.45	4.5	4.9	4.2
11	5.6	.....	4.2	7.2	5.7	4.15	4.6	4.3	4.9	4.4	4.8	.....
12	5.55	.....	4.0	8.0	5.4	4.65	4.5	.....	5.3	5.1	4.9	4.8
13	5.5	.....	4.5	7.8	5.4	.....	4.5	3.85	6.4	5.9	4.8	4.85
14	5.4	.....	4.6	7.3	4.7	5.65	4.7	4.1	5.9	5.3	4.8	4.8
15	4.7	.....	4.2	6.9	5.3	5.3	4.5	4.2	5.3	4.55	4.8	4.8
16	5.7	.....	4.0	6.45	5.6	5.0	4.1	4.4	5.1	4.8	4.7	4.8
17	5.95	.....	4.05	6.3	5.8	4.95	4.4	5.3	4.9	4.7	4.8	4.35
18	5.65	.....	4.0	5.8	5.7	.....	4.5	4.9	6.6	4.6	4.7	4.7
19	5.35	.....	3.8	5.75	5.7	4.75	4.4	4.7	11.85	4.6	4.2	4.6
20	5.05	.....	4.2	5.65	.....	4.7	4.3	.....	8.25	.....	4.4	4.75
21	4.9	.....	5.0	6.05	.....	4.65	4.6	4.2	7.6	4.85	4.4	4.7
22	.....	.....	5.05	7.95	.....	5.3	4.45	4.25	7.0	4.35	4.45	4.7
23	4.75	.....	4.9	.....	5.0	5.45	3.9	4.2	6.4	4.65	4.4	4.8
24	4.8	.....	4.85	6.6	5.0	5.1	4.1	4.1	5.3	4.7	4.5	4.2
25	5.3	.....	5.2	6.2	4.9	4.25	4.15	4.1	5.5	4.7	4.5	.....
26	5.4	.....	7.5	6.0	4.85	4.65	4.2	4.1	5.3	4.6	4.05	4.6
27	5.5	.....	9.8	6.0	4.8	6.9	4.2	.....	5.2	4.55	4.8	4.65
28	5.4	.....	11.1	6.1	4.55	6.4	4.2	4.8	5.1	4.6	4.75	4.6
29	5.5	.....	11.7	6.05	4.5	5.65	4.2	4.7	5.0	.....	4.85	4.7
30	.....	.....	13.0	.....	4.6	5.2	4.2	4.55	4.9	4.5	4.95	5.2
31	.....	.....	12.95	.....	4.6	.....	5.5	4.5	.....	4.4	.....	4.3

NOTE.—River open at gage January 1-29. River frozen January 30 to March 9.

Station rating table for Merrimac River at Franklin Junction, N. H., from July 8, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	795	5.00	2,220	6.10	4,125	7.20	6,250
4.00	910	5.10	2,380	6.20	4,310	7.40	6,660
4.10	1,030	5.20	2,540	6.30	4,500	7.60	7,075
4.20	1,150	5.30	2,705	6.40	4,690	7.80	7,500
4.30	1,270	5.40	2,875	6.50	4,880	8.00	7,930
4.40	1,395	5.50	3,045	6.60	5,070	8.20	8,370
4.50	1,520	5.60	3,220	6.70	5,265	8.40	8,815
4.60	1,645	5.70	3,395	6.80	5,460	8.60	9,265
4.70	1,775	5.80	3,575	6.90	5,655	8.80	9,715
4.80	1,915	5.90	3,755	7.00	5,850	9.00	10,170
4.90	2,065	6.00	3,940				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1903-1905. It is well defined between gage heights 4.15 feet and 8.9 feet.

Estimated monthly discharge of Merrimac River at Franklin Junction, N. H., for 1905.

[Drainage area, 1,460 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 10-31	19,830	680	5,150	3.53	2.89
April	17,580	3,308	6,006	4.11	4.59
May	5,460	1,520	2,976	2.04	2.35
June	5,655	1,090	2,397	1.64	1.83
July	6,150	795	1,824	1.25	1.44
August	5,070	738	1,586	1.09	1.26
September	16,960	1,458	4,701	3.22	3.59
October	3,755	1,030	1,785	1.22	1.41
November	2,460	970	1,763	1.21	1.35
December	9,152	1,150	2,484	1.70	1.96

NOTE.—Omitted gage heights were estimated and discharges applied as usual.

MERRIMAC RIVER AT GARVINS FALLS, N. H.

The power at Garvins Falls—4 miles below Concord—is one of the best on Merrimac River. There has been a dam at this point since 1815, first in connection with the Old Bow Canal and later to furnish power for a pulp mill. This privilege has since become the property of the Manchester Traction, Light, and Power Company, and has been more completely developed. During 1903–4 an overfall dam of the ogee type, somewhat similar in cross section to the dam at Holyoke, was completed. This is 550 feet long between abutments and about 800 feet over all, including headgates, and is substantially built of stone masonry. A canal has been completed which is about 500 feet long and 74 feet wide at the water line, and wasteways are provided from the sides of this—one 90 feet long at elevation 102 (the main crest of the dam being taken as elevation 100) and another 45 feet long at elevation 103. A waste gate 10 feet wide and capable of being lowered to elevation 93 is also provided for use especially in floating out any obstructions which lodge against the racks. The new dam and headgates to the canal are situated about 800 feet downstream

from the old dam, which was destroyed on the completion of the new structure. At present there are four triplex turbines of something over 1,000 horsepower each and one small duplex turbine of 75 horsepower used in running exciters. Provision has been made for two more large units, which will be installed later. The turbines are of the McCormick design, furnished by the Rodney Hunt Machine Company. Each large unit has three 39-inch runners, mounted on a horizontal shaft, which revolves at 180 revolutions a minute. Two of the wheels in each set discharge through a common T center and draft tube near the fore bay wall. The third wheel is set opposite a quarter turn at the downstream end of the casing and discharges through this quarter turn into a smaller draft tube. The top of the penstock opening is at elevation 95.5, while the lower ends of the draft tubes are horizontal and are about 2 feet below the level of usual tail water. The gates for the runners are of the plain cylindrical pattern without fingers and are controlled by governors. The average head on the wheels is about 29 feet. At present there are four 650-kilowatt three-phase generators direct connected with the turbines.

The power developed is transmitted at 12,000 volts tension to Manchester, about 14 miles away, where it enters a substation and is transformed to a lower voltage and through a distributing switch board utilized for light and power purposes. The Garvins Falls station is one of a system of three water-power plants and one steam-power plant operated by this company.

Careful records of the pond and tail-race levels, wheel openings, etc., have been kept by the company since the completion of the new dam in 1904, and have been furnished for computations of flow by J. Brodie Smith, manager. A number of current-meter measurements have been made from time to time by the hydrographers of the Survey for the purpose of rating turbines and to assist in computing flow over the dam. Estimates of monthly flow at this point from September 1, 1904, to December 31, 1905, are given in the following table:

Estimated monthly discharge of Merrimac River at Garvins Falls, N. H., for 1904–5.

[Drainage area, 2,340 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September	7,110	1,150	2,220	0.947	1.06
October	7,880	1,460	2,860	1.22	1.41
November	2,440	1,610	2,000	.856	.955
December	2,200	1,300	1,660	.710	.818
1905.					
January	3,440	1,490	2,190	.936	1.08
February	2,110	1,340	1,610	.690	.718
March	32,760	1,370	6,400	2.74	3.16
April	30,940	4,940	10,400	4.45	4.96
May	5,660	2,070	3,910	1.67	1.92
June	5,410	1,840	2,730	1.17	1.30
July	4,980	1,090	1,930	.824	.950
August	5,470	1,240	1,920	.823	.949
September	18,030	2,720	6,260	2.67	2.98
October	3,860	1,780	2,290	.978	1.13
November	4,030	1,810	2,560	1.10	1.23
December	9,990	2,250	3,880	1.66	1.91
The year	32,760	1,090	3,840	1.64	22.29

MERRIMAC RIVER AT LAWRENCE, MASS.

Records of flow of the Merrimac at Lawrence have been kept for more than fifty years, but have never been published in full. Data in regard to the flow are furnished by R. A. Hale, principal assistant engineer of the Essex Water Power Company.

For a portion of the year water from the drainage basins of Sudbury and Nashua rivers is wasted into the Merrimac, and therefore the drainage area is a somewhat variable quantity. During the dry months a very small amount is received. The accompanying tables give the flow of the Merrimac at Lawrence, also the quantity wasted from the Sudbury and Nashua drainage basins that reaches the Merrimac. The latter table is based on data furnished by the Metropolitan Water and Sewerage Board of Boston. The drainage areas are as follows:

Drainage areas in Merrimac River basin.

	Square miles.
Total of Merrimac River drainage basin above Lawrence	4,664
Nashua River drainage basin above gaging station	119
Sudbury River drainage basin, Framingham, Dam No. 1	75
Cochituate River drainage basin	19
Total of Nashua, Sudbury, and Cochituate river drainage basins	213
Net drainage basin of Merrimac River, excluding Nashua, Sudbury, and Cochituate river basins	4,451

The quantity as measured at Lawrence includes the water from Sudbury, Nashua, and Cochituate rivers, and in getting the absolute yield of the river this should be considered in reference to the drainage areas, either by deducting it from the Merrimac flow and using the net area and the net flow of the Merrimac, or by getting the total yield of both the Sudbury and Nashua rivers with the Merrimac and using the total area.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper; Bull = Bulletin):

Description: Ann, 19, iv, pp 111–112; Bull 140, p 33; WS 35, p 34; 47, p 32; 65, p 22; 82, pp 49–50; 97, p 72; 124, pp 89–90.

Discharge, daily: WS 35, pp 35–36; 47, p 33; 82, pp 51–52; 97, p 73; 124, pp 90–93.

Discharge, monthly: Ann 19, iv pp 113–115; 20, iv, p 73; 21, iv, p 60; Bull 140, p 34.

Discharge, yearly: Ann 20, iv, p 46.

Hydrographs: Ann 19, iv, p 112; 20, iv, p 74; 21, iv, p 60.

Mean daily discharge, in second-feet, of Merrimac River at dam at Lawrence, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	453	2,838	2,526	44,887	7,434	3,414	3,585	2,477	2,713	2,733	3,240	5,043
2	3,147	2,784	2,695	37,260	6,537	3,015	2,941	4,775	2,109	4,371	2,796	3,984
3	3,084	2,760	2,527	28,553	6,379	1,958	2,938	4,676	3,109	3,276	2,818	3,714
4	2,981	1,980	1,514	22,206	6,002	1,470	4,897	3,939	6,430	3,190	1,813	8,930
5	2,812	457	430	18,850	5,868	3,708	6,028	2,591	20,900	3,214	1,439	15,540
6	2,735	3,505	2,768	19,442	6,094	3,116	4,503	1,632	17,434	3,336	4,850	12,350
7	2,662	2,865	2,567	25,546	5,732	2,987	3,881	3,631	12,972	2,390	4,409	9,354
8	4,358	2,518	2,596	25,097	6,548	3,070	2,321	2,955	9,854	2,103	5,345	7,933
9	7,710	2,440	2,774	20,156	6,806	3,710	1,907	2,443	7,257	4,179	5,559	6,009
10	6,930	2,695	2,811	16,880	6,174	2,993	3,947	2,390	5,541	3,238	5,251	5,483
11	6,844	1,902	2,418	15,309	5,619	2,482	3,148	2,441	5,953	3,065	3,907	6,016
12	6,470	489	2,305	17,546	5,303	4,330	2,836	1,454	4,960	2,544	3,513	4,087
13	6,301	3,094	4,898	19,451	4,159	3,427	2,807	474	5,035	2,812	5,062	4,099
14	4,862	2,613	3,879	18,502	3,905	3,033	2,826	5,031	7,285	3,116	3,679	4,338
15	4,377	2,573	3,842	16,148	5,467	2,930	1,764	2,953	7,330	3,589	3,552	4,429
16	6,111	2,510	4,020	14,215	3,758	4,296	581	2,697	5,525	4,620	3,732	2,838
17	4,352	2,678	4,034	12,661	6,010	2,599	3,637	2,980	4,309	3,684	3,654	2,286
18	3,893	1,825	2,977	11,273	6,938	2,348	2,759	3,257	5,171	3,311	2,289	4,622
19	3,920	456	4,050	9,761	6,716	4,410	2,723	2,987	8,525	3,381	2,461	3,460
20	4,086	2,940	11,100	8,546	8,211	3,617	2,404	2,141	17,529	3,396	4,397	3,371
21	2,494	2,691	11,210	7,961	5,208	4,253	2,538	3,690	13,968	2,297	3,537	3,997
22	2,387	2,521	10,050	8,018	5,653	5,768	1,677	2,739	11,540	2,886	3,256	4,664
23	4,744	2,464	9,150	10,857	4,564	8,238	383	2,729	9,007	4,760	3,129	5,211
24	3,545	2,574	8,800	10,793	4,520	7,433	2,603	2,505	6,588	3,764	2,892	5,837
25	3,043	1,666	8,740	9,115	4,178	5,593	2,559	2,766	6,467	3,526	1,827	5,638
26	2,955	410	11,570	8,094	3,947	5,918	2,382	1,481	5,262	3,447	1,193	6,460
27	2,931	2,850	32,003	7,692	2,866	4,987	2,376	316	4,721	3,376	4,118	5,505
28	1,827	2,514	36,429	7,225	2,812	5,912	2,343	2,344	4,488	2,090	3,307	4,900
29	895	.....	41,219	6,856	4,343	7,300	1,403	2,458	4,133	1,851	3,212	4,890
30	3,996	.....	45,940	6,639	2,769	5,615	128	2,374	2,830	4,119	1,413	4,881
31	3,087	.....	45,617	.....	3,171	.....	2,079	2,445	.....	3,418	.....	6,432
Total	119,992	63,612	327,459	485,545	161,691	124,930	82,904	83,771	228,945	101,082	101,650	176,301
Average	3,871	2,272	10,563	16,185	5,216	4,164	2,674	2,702	7,631	3,261	3,388	5,687

Average weekly flow, arranged in order of dryness, of Merrimac River at Lawrence, Mass., for 1905.

Week ending Sunday—	Merrimac River at Lawrence (total drainage area=4,664 square miles).	Wasting into Merrimac River from— Nashua River at Clinton (drainage area=118 square miles).	Sudbury River at Dam 1 (drainage area=75 square miles).	Lake Cochituate, Bannister Brook (drainage area=19 square miles).	Total waste of these watersheds (total drainage area=212 square miles).	Net yield of Merrimac River from 4,452 square miles. Second-feet. Seven days.	Per square mile.
	Second-feet for seven days.						
July 30	1,971	4	2	0	6	1,965	0.441
March 5	2,151	3	2	0	5	2,146	.482
February 26	2,181	2	4	0	6	2,175	.489
February 19	2,250	3	40	2	45	2,205	.495
August 13	2,255	3	2	0	5	2,250	.505
July 23	2,303	4	2	0	6	2,297	.516
August 27	2,318	4	2	0	6	2,312	.519
February 12	2,345	3	42	0	45	2,300	.517
September 3	2,507	4	32	0	36	2,471	.555
February 5	2,557	4	36	0	40	2,517	.565
July 16	2,558	4	2	0	6	2,552	.573
March 12	2,606	4	11	0	15	2,591	.582
November 5	2,806	3	2	0	5	2,801	.629
January 29	2,845	3	41	0	44	2,801	.629
June 4	2,877	3	3	0	6	2,871	.645
November 26	2,890	3	2	0	5	2,885	.648
January 8	3,111	5	47	0	52	3,059	.687
October 8	3,126	4	68	0	72	3,054	.686
August 20	3,149	4	2	0	6	3,143	.706
June 11	3,152	4	2	3	9	3,143	.706
August 6	3,167	4	2	0	6	3,161	.710
October 15	3,220	3	6	0	9	3,211	.721
October 29	3,259	3	2	0	5	3,254	.731
October 22	3,368	3	4	0	7	3,361	.755
June 18	3,423	3	9	11	23	3,400	.764
November 19	3,490	3	2	0	5	3,485	.783
December 3	3,542	4	2	0	6	3,536	.794
July 9	3,782	3	2	0	5	3,777	.848
January 22	3,892	3	66	0	69	3,823	.859
March 19	3,957	4	80	0	84	3,873	.870
December 17	4,013	4	2	0	6	4,007	.900
May 28	4,077	4	8	0	12	4,065	.913
October 1	4,376	4	50	0	54	4,322	.971
December 24	4,452	3	2	0	5	4,447	.999
November 12	4,691	3	2	0	5	4,686	1.053
July 2	5,180	3	7	0	10	5,170	1.161
May 14	5,502	4	6	0	10	5,492	1.234
December 31	5,529	5	44	0	49	5,480	1.231
June 25	5,616	3	23	15	41	5,575	1.252
May 21	5,758	4	24	0	28	5,730	1.287
September 17	5,771	4	2	0	6	5,765	1.295
January 15	6,213	3	109	0	112	6,101	1.370
May 7	6,292	4	2	0	6	6,286	1.412
April 30	8,060	4	23	0	27	8,033	1.804

Average weekly flow, arranged in order of dryness, of Merrimac River at Lawrence, Mass., for 1905—Continued.

Week ending Sunday—	Merrimac River at Lawrence (total drainage area=4,664 square miles).	Wasting into Merrimac River from—				Net yield of Merrimac River from 4,452 square miles.	
		Nashua River at Clinton (drainage area=118 square miles).	Sudbury River at Dam 1 (drainage area=75 square miles).	Lake Cochituate, Bannister Brook (drainage area=19 square miles.)	Total waste of these watersheds (total drainage area=212 square miles).	Second-feet.	
	Second-feet for seven days.					Seven days.	Per square mile.
December 10	9,371	4	2	0	6	9,365	2.104
April 23	9,868	4	55	0	59	9,809	2.203
March 26	10,089	6	171	1	178	9,911	2.226
September 24	10,333	4	5	0	9	10,324	2.319
September 10	11,484	3	61	0	64	11,420	2.565
April 16	16,864	4	99	12	115	16,749	3.762
April 9	22,836	4	123	24	151	22,685	5.095
April 2	40,479	5	173	40	218	40,261	9.043
Total, 52 weeks	293,912	190	1,512	108	1,810	292,102	65.609
Weekly average	5,652	4	29	2	35	5,617	1,262

PEMIGEWASSET RIVER AT PLYMOUTH N. H.

This station was established September 5, 1903, by N. C. Grover. It is located at the wooden highway bridge below the mouth of Bakers River, in the town of Plymouth. The drainage area at this point is about 615 square miles. The headwaters of the river lie in the mountainous country to the west of Mount Washington, at elevations of more than 2,000 feet. At North Woodstock Pemigewasset River is formed by the junction of East Branch, Middle Branch, and Moosilauke Brook, at an elevation of about 700 feet. Thence the waters flow south, receiving Mad River from the east and Bakers River from the west, until at Plymouth, about 20 miles below North Woodstock, the elevation is between 400 and 500 feet. The underlying rock in this basin is usually granite, exposed in the mountain summits. The basin contains some of the best spruce standing in New England. Large areas in the basin of East Branch are still in virgin forest; other areas have been practically stripped, especially on Hancock Brook, a tributary of East Branch, and in the basin of Middle Branch.

The height of water at Plymouth has been recorded daily since January 1, 1886, during which time extensive deforestation in the basin above has taken place. This record of gage height has been given to the United States Geological Survey by the Locks and Canals Company, of Lowell, Mass. From these figures the monthly discharge of the river since that date was estimated from measurements of flow at the station during 1903 and 1904. These estimates were published in Water-Supply Paper No. 124, pp. 97–101.

The channel is straight for 1,000 feet above and below the bridge, and is about 180 feet wide at ordinary stages, broken by one pier. The banks are high and rocky. The bed is fairly permanent near the gage, but evidences of change in conditions below and consequent change in control as regards velocity have been observed during 1905. The bed is rocky in the right half and gravelly in the left. The velocity is rapid in the right and sluggish in the left half.

Discharge measurements at ordinary and high stages are made from the bridge. The initial point for soundings is at the top of the face of the right abutment on the upstream side. At low water the discharge of the left channel is measured by wading.

A standard chain gage, which is read twice each day by Frank Morton, is attached to the guard rail of the sidewalk of the bridge on the upstream side. The length of the chain is 34.69 feet. The gage is referred to bench marks as follows: (1) Marked point on rail of bridge near gage; elevation, 34.00 feet when established, but changed to 33.96 feet August 23, 1905. (2) North corner of intermediate cast-iron gage set by the Locks and Canals Company, of Lowell, Mass.; elevation, 13.27 feet. (3) North corner of lowest cast-iron gage set by same company; elevation, 7.11 feet. All elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 73–74; 124, pp 93–94.
Discharge: 97, p 74; 124, p 94.
Discharge, monthly: 124, pp 97–101.
Gage heights: 97, p 75; 124, p 95.
Rating table: 124, p 96.

Discharge measurements of Pemigewasset River at Plymouth, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*F. per sec.*	*Feet.*	*Sec.-feet.*
July 4	Murphy and Barrows	202	777	2.65	3.94	2,060
August 3[a]	H. K. Barrows	178	387	2.14	2.75	826
August 23[b]	T. W. Norcross	124	257	1.44	1.80	370
September 5	do	224	1,400	4.17	6.88	5,840
October 7[a]	do	142	282	1.65	2.01	466
October 28[a]	do	113	208	1.15	1.51	240
October 28[a]	do	113	208	1.31	1.57	272

[a] In left channel by wading. [b] In left channel by wading; meter fastened to rod.

Daily gage height, in feet, of Pemigewasset River at Plymouth, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	.....	.....	7.55	4.4	2.6	2.8	4.35	3.6	2.35	2.0	2.65
2	2.22	3.1	3.1	5.6	3.9	2.4	2.8	3.3	3.3	2.2	2.2	2.8
3	2.32	.....	.....	4.6	3.6	2.35	6.0	2.8	4.8	2.3	2.0	3.6
4	2.42	.....	.....	4.4	4.2	2.4	4.05	2.5	8.8	2.25	2.15	6.3
5	2.5	.....	.....	4.2	4.3	2.35	3.3	2.3	7.15	2.2	2.4	4.15
6	.....	.....	.....	5.7	4.0	3.3	2.95	2.15	5.2	2.15	2.45	3.75
7	.....	.....	.....	6.3	5.15	3.6	2.8	2.1	4.25	2.0	2.5	3.3
8	3.4	.....	.....	5.05	4.75	3.05	2.6	2.1	3.6	2.0	2.6	3.1
9	4.1	2.85	2.85	4.6	4.1	2.9	2.4	2.0	3.25	2.05	2.55	2.9
10	4.25	.....	.....	4.6	4.0	2.6	2.4	2.1	2.9	2.0	2.4	2.65
11	4.02	.....	.....	5.65	3.6	2.4	2.2	1.9	2.6	1.9	2.3	1.8
12	.....	.....	.....	5.8	3.4	2.7	2.15	1.9	3.0	3.1	2.25	3.45
13	.....	.....	.....	5.6	3.3	4.55	2.5	1.8	4.3	3.65	2.25	3.45
14	.....	.....	.....	5.1	3.2	3.6	2.25	1.9	3.4	3.9	2.3	3.0
15	3.7	.....	.....	5.0	3.2	3.1	2.25	1.8	2.9	3.4	2.2	3.1
16	.....	3.25	2.65	4.35	3.7	2.8	2.1	2.25	2.7	2.7	2.2	3.4
17	.....	.....	.....	4.0	3.55	2.6	2.0	3.3	2.6	2.3	2.1	3.6
18	.....	.....	.....	3.65	3.8	2.5	2.3	2.5	6.2	2.15	1.95	3.5
19	3.2	.....	.....	3.4	3.85	2.4	2.1	2.2	8.15	2.3	1.85	3.4
20	.....	.....	.....	3.35	3.6	2.3	2.5	1.9	5.1	2.65	1.8	3.3
21	.....	.....	4.85	4.05	3.3	2.35	2.2	1.9	5.65	2.9	2.05	3.1
22	3.2	.....	.....	6.9	3.1	3.35	2.05	1.75	4.35	2.65	2.2	3.1
23	.....	2.95	4.15	5.2	2.9	3.1	1.85	1.8	3.6	2.4	1.95	3.1
24	.....	.....	.....	4.4	2.8	2.7	1.85	1.7	3.3	2.35	1.95	3.0
25	.....	.....	3.9	4.3	2.65	2.45	1.9	1.7	3.05	2.15	2.0	2.8
26	3.25	.....	8.6	4.15	2.6	2.95	1.75	1.7	3.0	2.15	2.4	2.9
27	.....	.....	9.15	4.5	2.85	6.3	1.8	2.2	2.85	2.2	2.45	2.75
28	.....	.....	13.1	4.7	2.9	4.25	1.8	2.8	2.7	1.85	2.2	2.7
29	.....	.....	11.85	4.7	2.75	3.6	1.8	2.35	2.6	1.95	2.4	2.7
30	.....	.....	8.65	4.5	2.7	3.1	1.7	2.0	2.5	1.9	5.0	4.0
31	.....	.....	9.25	.....	2.7	.....	5.3	4.0	.....	2.05	.....	3.75

NOTE.—River frozen January 5 to March 28. Ice jam in latter part of March affected gage heights. Ice went out March 28. During frozen season gage heights were read to the surface of the water in a hole cut in the ice, except January 15 and March 21, when readings were taken to the top of the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 19	3.2	3.3	0.6	February 16	3.25	3.5	1.3
January 22	3.2	3.3	.7	February 23	2.95	3.15	1.3
January 26	3.25	3.4	1.0	March 2	3.1	3.3	1.3
February 2	3.1	3.3	1.1	March 9	2.85	3.0	1.4
February 9	2.85	3.0	1.2	March 16	2.65	2.85	1.0

January 8, water on top of ice.

CONTOOCOOK RIVER AT WEST HOPKINTON, N. H.

This station was established July 9, 1903, by H. K. Barrows. It is located at the wooden highway bridge near the railway station at West Hopkinton.

The channel is straight for 300 feet above and 500 feet below the station and is about 125 feet wide at ordinary stages. The banks are high and rocky and not subject to overflow. The bed is rough and rocky, but permanent, and the current is rapid.

Discharge measurements are made from the bridge. The initial point for soundings is at the downstream side of the left abutment at the top.

A standard chain gage, which is read twice each day by Frank H. Carr, is attached to the downstream side of the board covering of the bridge. The length of the chain was 26.11 feet when established, but changed to 26.04 feet August 29, 1905, owing to settling of the bridge. The gage is referred to bench marks as follows: (1) Point on the railing of bridge near the gage; elevation, 25.35 feet above gage datum. (2) The highest point of the large rock on the south side of the road, 15 feet northwest of the left abutment; elevation, 21.55 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 75; 124, pp 101-102.
Discharge: 97, p 75; 124, p 102.
Discharge, monthly: 124, p 104.
Gage heights: 97, p 75; 124, p 103.
Rating table: 124, p 104.

Discharge measurements of Contoocook River at West Hopkinton, N. H., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 1	F. E. Pressey	152	109	8.05	9.08	8,770
April 3	do	142	657	6.64	6.42	4,360
April 3	do	142	643	6.51	6.31	4,190
April 6	do	139	602	6.36	6.08	3,830
April 6	do	139	584	6.15	5.93	3,590
April 10	T. W. Norcross	133	472	5.09	5.08	2,400
April 12	do	139	574	5.85	5.80	3,360
April 12	do	139	574	5.84	5.80	3,350
August 29[a]	do	109	138	1.36	2.40	187
November 22[a]	do	110	163	1.56	2.64	254

[a] Partly by wading—same section.

Daily gage height, in feet, of Contoocook River at West Hopkinton, N. H., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.3	3.5	2.8	2.9	3.4	2.6	2.9	2.7	3.3
2	.....	7.7	3.4	2.9	2.9	3.15	2.7	2.7	2.6	3.4
3	.....	6.7	3.4	2.85	2.8	3.0	3.0	2.7	2.7	4.0
4	.....	6.15	3.6	2.8	2.7	2.85	5.05	2.8	2.85	5.55
5	.....	5.8	3.8	2.8	2.7	2.7	5.3	2.75	2.9	5.4
6	.....	6.3	3.7	2.65	2.65	2.6	5.0	2.7	3.0	4.4
7	.....	6.7	3.6	2.8	2.65	2.75	4.25	2.6	3.25	3.8
8	.....	6.3	3.5	2.95	2.7	2.85	3.65	2.6	3.7	3.75
9	.....	5.65	3.4	2.95	2.65	2.9	3.35	2.5	3.55	3.7
10	.....	5.3	3.3	3.0	2.7	2.8	3.15	2.45	3.3	3.6
11	.....	5.5	3.25	2.9	2.6	2.8	2.9	2.6	3.2	3.75
12	.....	5.9	3.25	2.8	2.6	2.75	3.2	2.8	3.05	3.9
13	.....	5.9	3.2	2.8	2.5	3.05	3.95	3.05	2.8	3.75
14	.....	5.5	3.15	2.85	2.5	3.15	4.1	3.0	2.8	3.85
15	.....	5.25	3.1	2.8	2.55	3.1	3.75	2.9	2.7	4.2
16	.....	5.0	3.35	2.85	2.5	3.15	3.4	2.9	2.7	4.5
17	.....	4.7	3.8	2.8	2.55	3.25	3.3	2.75	2.8	4.4
18	.....	4.45	3.8	2.7	2.45	3.45	3.45	2.7	2.8	4.15
19	.....	4.3	3.7	2.8	2.55	3.2	5.5	2.85	2.7	3.95
20	.....	4.2	3.6	2.8	2.55	3.0	5.1	2.95	2.7	3.65
21	.....	4.1	3.5	3.0	2.55	2.7	4.6	3.1	2.7	3.7
22	.....	4.1	3.3	3.6	2.5	2.8	4.3	3.0	2.7	3.7
23	.....	4.05	3.25	4.15	2.35	2.7	3.95	2.85	2.6	3.75
24	.....	3.9	3.2	3.8	2.4	2.7	3.65	2.8	2.7	3.8
25	.....	3.9	3.15	3.3	2.45	2.65	3.45	2.8	2.65	3.85
26	8.3	3.8	3.1	3.15	2.55	2.6	3.3	2.75	2.65	3.6
27	10.2	3.7	3.0	3.25	2.5	2.55	3.2	2.7	2.6	3.4
28	11.0	3.6	3.0	3.45	2.5	2.6	3.1	2.7	2.65	3.4
29	11.2	3.6	2.9	3.25	2.6	2.65	3.0	2.7	2.8	3.25
30	11.5	3.6	2.8	3.15	2.45	2.6	3.0	2.65	3.3	3.65
31	10.9	.....	2.85	.....	2.85	2.6	.....	2.6	.....	3.7

NOTE.—Ice January 1 to April 1 and December 11–31.
March 27, back water from ice jam below bridge. April 1, river clear of ice. Anchor ice in river December 11–17 and probably more or less after that time.

Station rating table for Contoocook River at West Hopkinton, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	165	3.30	582	4.30	1,465	5.30	2,685
2.40	185	3.40	651	4.40	1,575	5.40	2,820
2.50	209	3.50	724	4.50	1,690	5.50	2,960
2.60	237	3.60	801	4.60	1,805	5.60	3,100
2.70	270	3.70	882	4.70	1,925	5.70	3,245
2.80	308	3.80	967	4.80	2,045	5.80	3,395
2.90	352	3.90	1,056	4.90	2,165	5.90	3,550
3.00	402	4.00	1,150	5.00	2,290	6.00	3,710
3.10	457	4.10	1,250	5.10	2,420		
3.20	517	4.20	1,355	5.20	2,550		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 2.4 feet and 9 feet. Above gage height 6 feet the rating curve is a tangent, the difference being 164 per tenth.

Estimated monthly discharge of Contoocook River at West Hopkinton, N. H., for 1905.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	9,122	801	2,711	6.61	7.38
May	967	308	624	1.52	1.75
June	1,302	254	442	1.08	1.20
July	352	175	240	.585	.674
August	688	223	357	.871	1.00
September	2,960	237	1,043	2.54	2.83
October	457	197	303	.739	.852
November	882	237	361	.880	.982

SUNCOOK RIVER AT EAST PEMBROKE, N. H.

Suncook River enters the Merrimac about 6 miles below Concord and is about 27 miles long. It has a total drainage area of about 270 square miles. The drainage basin is hilly and broken. Bed and banks are apt to be rocky. This river has a large fall, a considerable part of which has been developed.

A temporary gaging station was established at East Pembroke November 3, 1904, by H. K. Barrows. This was discontinued June 30, 1905. The drainage area at this point is about 250 square miles. A wooden staff gage, which was read twice each day by George P. Cass, was fastened to the abutment of the highway bridge over the canal channel to a mill near this point, which was recently destroyed by fire. It is near the Allenstown station, on the Boston and Maine Railroad. When the gaging station was first established and for some little time afterwards all of the water, except a slight amount which leaked through the dam, was flowing through this canal channel. During the high water which occurred about March 26, 1905, a portion of the dam was carried away, so that after this date a considerable part of the flow passed through the channel in which the dam was located. Current-meter measurements made before March 26 will not apply in considering data subsequent to that time.

Discharge measurements of Suncook River at East Pembroke, N. H., in 1904 and 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
November 3 [a]	H. K. Barrows	40	61	1.77	1.68	108
December 21 [b]	T. W. Norcross	25	34	1.41	1.26	48
1905.						
March 20 [c]	F. E. Pressey	60	102	2.74	2.54	280
April 4 [d]	do	121	480	3.73	4.63	1,790
April 7 [e]	do	121	525	3.87	4.95	2,030
August 28 [f]	T. W. Norcross	113	193	1.56	1.97	302

[a] Includes 3 second-feet in right channel.
[b] No flow in right channel.
[c] Includes 30 second-feet (estimated) in right channel.
[d] Includes 700 second-feet (estimated) in right channel.
[e] Includes 851 second-feet in right channel.
[f] Includes 74 second-feet in right channel.

Daily gage height, in feet, of Suncook River at East Pembroke, N. H., for 1904 and 1905.

Day.	1904.		1905.					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	.....	1.8	1.65	1.5	1.15	6.65	2.3	1.75
2	.....	1.8	1.65	1.8	1.05	.....	2.0	1.65
3	1.7	1.85	1.65	1.5	1.05	5.3	1.95	1.9
4	1.8	1.65	1.6	1.5	1.05	4.75	1.95	.....
5	1.8	1.6	1.55	.....	.....	4.65	2.05	1.2
6	1.7	1.85	1.55	1.35	1.05	5.4	2.0	1.75
7	.9	1.8	1.75	1.45	1.05	5.15	.....	1.95
8	1.8	1.8	.....	1.45	1.15	4.7	2.05	2.05
9	1.8	1.5	2.7	1.55	1.15	.....	1.9	1.8
10	1.8	1.45	3.0	1.55	1.25	3.8	1.8	1.75
11	1.75	1.15	2.85	1.45	1.25	4.0	1.8	.....
12	1.75	1.2	2.75	.....	.....	4.25	1.8	1.65
13	1.3	1.35	2.55	1.4	1.15	4.05	1.75	1.8
14	1.2	1.3	2.55	1.45	1.15	3.7	.....	1.85
15	1.95	1.35	.....	1.45	1.25	3.45	1.3	1.7
16	1.95	1.4	1.45	1.35	1.25	.....	2.95	1.65
17	1.9	1.4	2.15	1.35	1.35	3.0	3.0	1.55
18	1.85	.....	2.15	1.4	1.4	2.75	2.6	.....
19	1.75	1.2	2.1	.....	.....	2.8	2.55	1.8
20	1.25	1.0	2.15	1.25	2.6	2.8	2.05	2.45
21	1.3	1.0	1.9	1.25	2.8	2.8	.....	2.05
22	1.8	.....	.....	1.15	2.75	2.8	2.15	3.15
23	1.65	.....	1.45	1.15	2.7	.....	2.1	2.85
24	1.9	.....	1.45	1.05	2.6	2.65	2.1	2.4
25	1.65	.....	1.4	1.05	2.9	2.6	2.1	.....
26	1.7	.....	1.65	.....	.....	2.4	1.95	2.0
27	1.55	1.0	1.95	1.0	6.15	2.35	1.95	3.15
28	1.55	1.5	1.95	1.15	6.75	2.15	.....	2.7
29	1.8	1.7	.....	.....	7.1	2.1	1.15	2.25
30	1.85	1.75	1.3	.....	7.2	.....	1.5	1.95
31	.....	1.6	1.3	.....	7.05	.....	1.55	.....

NOTE.—Water below gage December 22-27, 1904; reading December 27 taken in the afternoon. After March 26, 1905, conditions changed, owing to a portion of the dam in the right channel being carried away. Station discontinued June 30, 1905.

SUDBURY RIVER AT FRAMINGHAM AND LAKE COCHITUATE AT COCHITUATE, MASS.

Sudbury River, a small stream of eastern Massachusetts, receives water from an area west of Framingham. It flows thence in a northerly course through meadows and swamps and joins Assabet River to form Concord River, which in turn continues northward, entering Merrimac River immediately below the city of Lowell. Storage reservoirs have been constructed by the city of Boston and the Metropolitan Water and Sewerage Board, controlling the greater part of the flow from this basin.

Lake Cochituate drains into Sudbury River a short distance below Framingham. It is controlled as a storage reservoir by the metropolitan waterworks.

Sudbury River and Lake Cochituate have been studied by the engineers of the city of Boston, the State board of health of Massachusetts, and the Metropolitan Water and Sewerage Board, and records of rainfall in the Sudbury basin have been kept since 1875 and in the Cochituate basin since 1852, but the latter are considered of doubtful accuracy previous to 1872.

The accompanying tables, furnished by Frederic P. Stearns, give the results for 1905, also the averages for thirty-one years for Sudbury River and for forty-three years for Lake Cochituate:

Information in regard to this basin is contained in the following publications of the United States Geological Survey. (Ann=Annual Report; WS=Water-Supply Paper; Bull=Bulletin.)

SUDBURY RIVER.

Description: Ann 20, iv, pp 74-75; WS 47, p 33.
Discharge, weekly: Bull 140, pp 36-37.
Discharge, monthly: WS 35, p 37.
Discharge, yearly: Ann 20, iv, p 46.

SUDBURY RIVER NEAR FRAMINGHAM.

Description: WS 82, p 52; 97, p 76; 124, p 105.
Discharge, monthly: WS 82, p 53; 97, p 77; 124, p 106.
Rainfall data: WS 82, p 52; 97, p 77.

SUDBURY RIVER BASIN.

Description: Ann 21, iv, p 61; Bull 140, pp 35-36; WS 65, p 26.
Discharge: WS 47, p 34.
Discharge, monthly: Ann 20, iv, p 75; WS 35, p 37; WS 65, p 26; 82, pp 50-51.
Discharge, monthly and yearly: Ann 20, iv, p 75.
Map: Ann 21, iv, p 61.
Rainfall data: WS 65, p 26.

LAKE COCHITUATE.

Description: WS 35, pp 37-38; 47 p 33.
Discharge, monthly: WS 35, pp 37, 38.

LAKE COCHITUATE NEAR COCHITUATE.

Description: WS 82, p 52; 97, p 76; 124, p 105.
Discharge: WS 82, p 54.
Discharge, monthly: WS 82, p 54; 97, p 78; 124, p 107.
Rainfall data: WS 82, p 54; 97, p 78; 124, p 107.

LAKE COCHITUATE WATERSHED.

Description: WS 65, p 26.
Discharge: WS 47, p 34.
Discharge, monthly: WS 65, p 26; 82, pp 50-51.
Rainfall data: WS 65, p 26.

Yield and rainfall in Sudbury River watershed at Framingham, Mass.

[Drainage area, 75.2 square miles.]

Month.	Total yield, in million gallons.	Average yield of 1 square mile.		Rainfall in inches.[a]	Rainfall collected, in inches.[a]	Per cent collected.
		Million gallons per day.	Second-feet.			
1905.						
January	3,288.0	1.410	2.182	5.26	2.516	47.8
February	694.2	.330	.510	2.20	.531	24.2
March	5,822.1	2.497	3.864	3.15	4.456	141.5
April	3,707.4	1.643	2.543	2.72	2.837	104.2
May	693.4	.297	.460	1.31	.530	40.4
June	1,054.0	.467	.723	5.00	.806	16.1
July	413.6	.177	.275	5.47	.316	5.8
August	266.6	.114	.177	2.70	.204	7.6
September	2,811.6	1.246	1.928	6.88	2.152	31.3
October	369.0	.158	.245	1.54	.282	18.3
November	629.0	.279	.431	2.07	.481	23.3
December	2,068.8	.887	1.373	4.01	1.583	39.5
The year	21,817.7	.795	1.230	42.31	16.694	39.5
1875–1905.						
January	88,385.2	1.223	1.892	4.24	2.182	51.5
February	119,212.5	1.812	2.803	4.27	2.942	68.9
March	214,677.9	2.971	4.596	4.55	5.299	116.6
April	146,900.8	2.100	3.249	3.58	3.626	101.3
May	80,518.0	1.114	1.724	3.28	1.987	60.6
June	36,381.4	.520	.805	3.15	.898	28.5
July	13,926.9	.193	.298	3.73	.344	9.2
August	20,605.6	.285	.441	4.01	.509	12.7
September	18,927.8	.271	.419	3.43	.467	13.6
October	35,762.9	.495	.766	4.14	.883	21.3
November	59,406.4	.849	1.314	3.89	1.466	37.6
December	77,764.9	1.076	1.665	3.82	1.920	50.2
The period	912,470.3	1.072	1.658	46.09	22.523	48.9

[a] Total for month for 1905; average of totals per calendar month, 1875 to 1905.

Yield and rainfall in Cochituate Lake watershed at Cochituate, Mass.

[Drainage area, 18.87 square miles.]

Month.	Total yield, in million gallons.	Average yield of 1 square mile.		Rainfall in inches.[a]	Rainfall collected in inches.[a]	Per cent collected.
		Million gallons per day.	Second-feet.			
1905.						
January	689.6	1.179	1.824	5.40	2.10	38.9
February	144.1	.273	.422	2.00	.44	22.0
March	1,182.1	2.021	3.127	3.28	3.60	109.9
April	755.2	1.334	2.064	2.87	2.30	80.2
May	200.6	.343	.531	1.57	.61	39.0
June	235.4	.416	.643	5.46	.72	13.2
July	68.0	.116	.180	3.24	.21	6.4
August	216.0	.369	.571	2.89	.66	22.8
September	602.7	1.065	1.647	7.00	1.84	26.3
October	258.9	.443	.685	1.35	.79	58.5
November	321.2	.567	.878	2.07	.98	47.3
December	528.4	.903	1.398	4.07	1.61	39.6
The year	5,202.2	.755	1.169	41.20	15.86	38.5
1863–1905.						
January	28,311.6	1.126	1.741	3.97	2.01	50.5
February	36,072.0	1.575	2.436	3.98	2.56	64.2
March	56,066.2	2.228	3.448	4.42	3.98	89.9
April	42,068.0	1.728	2.674	3.68	2.98	81.1
May	24,696.5	.982	1.519	3.68	1.75	47.6
June	11,360.2	.467	.722	3.07	.81	26.3
July	7,397.6	.294	.455	4.11	.53	12.8
August	10,685.7	.425	.657	4.37	.76	17.3
September	10,634.6	.437	.676	3.59	.75	21.0
October	14,557.2	.579	.895	4.33	1.03	23.8
November	19,806.4	.814	1.259	4.12	1.40	34.1
December	24,180.2	.961	1.487	3.56	1.71	48.2
The period	285,836.2	.965	1.492	46.87	20.27	43.2

[a] Total per month for 1905; average of totals per calendar month 1863 to 1905.

SOUTH BRANCH NASHUA RIVER AT CLINTON, MASS.

Since July, 1896, the flow of South Branch of Nashua River has been measured at Clinton by the engineers of the Metropolitan Water and Sewerage Board. The results of these measurements have been furnished by Frederic P. Stearns, chief engineer. A large storage reservoir has been constructed at Clinton, Mass. Water was stored to an appreciable extent in this reservoir during 1903. Beginning with 1897 the flow has been corrected for loss and gain of storage in ponds and mill reservoirs on the watershed, so that the results show the natural flow of the stream. The accompanying tables give the results for 1905, also the average for the years 1897–1905, inclusive.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 22–24; 82, pp 54–55; 97, pp 78–79; 124, p 108.
Discharge, monthly: 65, pp 24–25; 82, p 55; 97, p 79; 124, pp 108–109.
Rainfall data: 65, pp 24–25; 82, p 55; 97, p 79; 124, p 108.

Yield and rainfall in South Branch, Nashau River watershed, at Clinton, Mass.

[Drainage area, 119 square miles.]

Month.	Total yield in million gallons.	Average yield of 1 square mile.		Rainfall in inches.[a]	Rainfall collected in inches.[a]	Per cent collected.
		Million gallons per day.	Second-feet.			
1905.						
January	4,669.6	1.266	1.959	6.10	2.258	37.0
February	1,507.2	.452	.700	1.72	.729	42.3
March	11,081.1	3.004	4.648	3.95	5.258	135.7
April	5,774.1	1.617	2.502	2.60	2.792	107.6
May	1,641.3	.445	.688	.83	.794	99.2
June	1,933.8	.542	.838	4.88	.935	19.2
July	1,347.2	.365	.565	5.39	.651	12.1
August	1,184.5	.321	.497	3.09	.573	18.5
September	4,383.5	1.228	1.900	6.90	2.119	30.7
October	1,352.6	.367	.567	1.81	.654	36.0
November	1,579.0	.442	.684	2.52	.763	30.4
December	3,754.5	1.018	1.575	3.79	1.816	47.9
The year	40,208.4	.926	1.432	43.58	19.442	44.6
1897–1905.						
January	39,223.7	1.181	1.827	3.89	2.107	54.1
February	43,361.1	1.440	2.228	3.87	2.330	60.2
March	105,107.7	3.165	4.897	4.92	5.647	114.9
April	80,680.5	2.511	3.885	4.29	4.335	101.1
May	40,833.1	1.230	1.902	3.16	2.194	69.5
June	28,481.3	.887	1.372	4.45	1.530	34.4
July	16,972.4	.511	.791	4.54	.912	20.1
August	17,013.4	.512	.793	4.40	.914	20.8
September	14,601.5	.454	.703	3.90	.785	20.1
October	19,477.2	.587	.907	3.54	1.046	29.6
November	26,160.8	.814	1.260	3.63	1.406	38.7
December	50,752.5	1.529	2.365	4.76	2.727	57.4
The period	482,665.2	1.234	1.910	49.35	25.933	52.6

[a] Total per month for 1905; average of totals per calendar month 1897 to 1905.

BLACKSTONE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Blackstone River rises in Worcester County, near the city of Worcester, Mass., flowing in a southeasterly course and emptying into Providence River at Providence, below Pawtucket, R. I., where it is generally known as Seekonk River. It has always been important as a water-power stream, and has been very fully developed in this way. There are no large lakes in the basin, but numerous small ponds and reservoirs are used for storage and the flow of the river is fairly constant. It has numerous tributaries, all of which, though small, are utilized for power purposes.

BLACKSTONE RIVER NEAR WOONSOCKET, R. I.

This station was established April 5, 1904, by N. C. Grover. It is located at River Street Bridge, about midway between the railway station at Woonsocket, R. I., and that at Blackstone, Mass., being 1½ miles from either of these two points. It is about 1 mile below the dam at Blackstone and three-fourths of a mile above the dam at Woonsocket. The drainage area at this point is 360 square miles.

The channel is straight for about 500 feet above and 800 feet below the station. The banks are high, rocky, and clean, and are not subject to overflow. The bed of the stream is of rock, gravel, and sand, and free from vegetation. The velocity is medium but well sustained during low water. During 1905 it has been found that this station is considerably influenced by backwater effect from the dam at Woonsocket, and consequently that gage readings probably do not give a true index of the flow during medium and low stages.

Discharge measurements are made from the two-span bridge. The initial point for soundings is the face of the right abutment on the downstream side.

A standard chain gage, which is read twice each day by Gerald Fitzgerald, is attached to the upstream side of the steel highway bridge. The length of the chain is 22.57 feet. The gage is referred to bench marks, as follows: (1) On the corner of the upstream face of the right abutment; elevation, 18.23 feet. (2) A marked point on the bridge near the gage; elevation, 20.26 feet. (3) On the upstream face of left abutment; elevation, 18.46 feet. Elevations refer to gage datum.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 109–110.

Discharge measurements of Blackstone River near Woonsocket, R. I., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per. sec.*	*Feet.*	*Sec.-feet.*
March 29	T. W. Norcross	127	884	2.32	4.91	2,050
March 31	do	127	774	1.95	4.13	1,510
March 31	do	127	763	1.94	4.08	1,480
May 27	do	126	478	.36	1.86	174
July 26	do	126	553	.66	2.49	366

Daily gage height, in feet, of Blackstone River near Woonsocket, R. I., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.6	2.6	2.2	2.1	2.2	2.2	2.4	2.3	2.5
2	.....	3.5	2.7	2.0	a1.8	a1.8	2.4	2.4	2.3	2.2
3	.....	3.6	2.7	2.4	a1.9	2.2	2.4	2.6	2.2	2.6
4	.....	3.2	2.6	2.6	2.2	2.2	3.6	2.6	1.9	2.8
5	.....	3.2	2.6	2.4	2.3	2.2	4.0	2.4	2.4	2.8
6	.....	5.0	2.6	2.4	2.2	a1.8	3.6	2.4	2.5	2.6
7	.....	5.5	2.6	2.6	2.5	2.2	3.2	2.5	2.5	2.5
8	.....	4.6	2.8	2.8	2.4	2.2	2.8	2.4	2.4	2.6
9	.....	4.0	2.7	2.8	2.3	2.3	3.0	2.4	2.4	2.3
10	.....	3.8	2.6	2.8	2.2	2.2	2.7	2.3	2.4	2.6
11	.....	3.6	2.6	2.5	2.2	2.4	2.8	2.4	2.0	2.6
12	.....	4.1	2.8	2.4	2.1	2.0	2.4	2.5	2.0	2.6
13	.....	4.2	2.5	3.6	2.0	2.1	2.8	2.4	2.6	2.5
14	.....	3.7	2.6	2.9	2.0	2.4	2.6	2.4	2.1	2.5
15	.....	3.6	2.4	2.6	2.4	2.4	2.8	2.2	2.1	2.4
16	.....	3.3	2.6	2.4	2.6	2.4	2.7	2.4	2.0	2.2
17	.....	3.2	2.6	2.6	2.4	2.4	2.6	2.4	2.0	2.5
18	.....	3.0	2.7	2.5	2.4	2.4	2.6	2.4	2.0	2.4
19	.....	2.9	2.8	2.3	2.2	2.2	2.6	2.4	2.3	2.4
20	.....	3.2	2.9	2.4	2.2	a1.8	2.8	2.6	2.2	2.4
21	.....	3.3	2.6	2.4	2.4	2.2	2.6	2.4	2.4	2.4
22	.....	3.4	2.6	2.8	2.2	2.2	2.2	2.5	2.2	2.8
23	3.7	3.2	2.6	2.9	a1.9	2.1	2.2	2.5	2.2	2.8
24	3.8	3.2	2.6	3.1	2.4	2.3	2.4	2.6	2.2	2.8
25	4.8	3.0	2.6	2.9	2.0	2.4	2.6	2.5	1.8	2.8
26	5.8	3.1	2.5	2.8	2.4	2.4	2.4	2.6	2.1	2.7
27	5.7	2.9	2.1	2.6	2.1	2.4	2.4	2.5	2.1	2.6
28	5.3	2.8	2.5	2.8	2.0	2.3	2.6	2.4	2.3	2.6
29	5.0	2.7	2.6	2.6	2.2	2.2	2.4	2.4	2.2	3.0
30	4.2	2.8	2.6	2.4	1.6	2.1	2.4	2.4	2.4	3.5
31	3.9	.....	2.6	.....	2.4	2.2	.....	2.3	.....	3.1

a Gage heights not true indications of flow, as water was drawn down at dam, one-half mile below.

NOTE.—River frozen January 1 to March 22. Gage heights are affected by backwater from Woonsocket dam and are unreliable.

THAMES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Thames River drains the eastern part of Connecticut and small portions of Rhode Island and Massachusetts. The country thus included is hilly and contains many natural lakes and ponds, which have been improved for reservoir purposes. This is a great manufacturing section, being especially noted for its cotton and woolen industries, and there are many important water-power privileges, both developed and undeveloped.

The Thames is formed at Norwich, Conn., by the union of Shetucket and Yantic rivers, and at a distance of about 4½ miles from New London enters Long Island Sound. It is a tidal stream below Norwich. A few miles above Norwich Quinnebaug River enters the Shetucket from the east. This stream is the most important tributary of the Shetucket as regards size, storage facilities, etc. It rises in the town of Brimfield, in the southern part of Massachusetts, and has a total length of about 60 miles. At Willimantic the Shetucket divides into Willimantic and Nachaug rivers, which are, especially the former, important water-power streams.

The drainage areas of the Thames and its principal tributaries are given in the following table:

Drainage areas of Thames River and principal tributaries.

River.	Locality.	Area.
		Sq. miles.
Thames	Norwich	1,300
Do	New London	1,400
Willimantic	Mouth	228
Nachaug	do	169
Quinnebaug	do	688
Shetucket	do	1,200
Do	Willimantic at gaging station	396
Yantic	Mouth	98

SHETUCKET RIVER NEAR WILLIMANTIC, CONN.

This station was established April 4, 1904, by N. C. Grover. It is located at the highway bridge (locally known as Bingham Bridge) about 1 mile below Willimantic and 1 mile below the junction of Willimantic and Nachaug rivers.

The channel is straight for about 800 feet above and below the station, and there are two channels at all stages. The banks are high, rocky, and clean, and not subject to overflow. The bed of the stream is of rock and permanent. The current is swift at high stages, but medium and rather poorly distributed at low water. Owing to pondage at the Willimantic dam it is difficult to obtain gage readings which correctly represent the daily flow at this point.

Discharge measurements are made from the two-span steel bridge, total length 200 feet. The initial point for soundings is the extreme outer edge of the end column of the downstream truss at the left bank.

A standard chain gage, which is read twice each day by David Martin, is attached to the downstream side of the bridge near the center of the left span, The length of the chain is 22.49 feet. The gage is referred to bench marks as follows: (1) Marked point on bridge near the gage scale; elevation, 21.46 feet when established, but changed to 21.39 feet September 6, 1905. (2) Top of left abutment on the downstream corner; elevation, 21.76 feet. (3) Top of face of right abutment on the downstream corner; elevation, 21.19 feet. (4) Top of downstream point of the pier; elevation, 19.77 feet. All elevations refer to gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pages 112–113.

Discharge measurements of Shetucket River near Willimantic, Conn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 29	T. W. Norcross	154	896	3.19	6.10	2,860
March 31	do	154	746	2.60	5.16	1,940
April 7	do	154	917	3.32	6.33	3,050
May 16	do	143	519	1.58	3.62	822
May 27	do	135	405	1.08	2.85	439
July 28	do	131	364	.87	2.51	316
July 28	do	124	296	.45	2.01	133
September 6	do	135	563	1.95	4.15	1,100

Daily gage height, in feet, of Shetucket River near Willimantic, Conn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			3.2	4.4	3.2	2.4					2.5	3.1
2			2.8	4.2	3.0	2.4					2.3	3.1
3			2.4	4.2	2.8	1.8					2.5	3.4
4			2.7	4.1	3.0	1.6					2.4	6.2
5			2.5	5.2	2.9	2.2					2.2	5.1
6			3.3	7.4	2.8	2.9					3.1	4.3
7			3.4	6.8	2.9	3.1					2.5	3.4
8			3.6	5.2	2.8	3.2					2.5	3.4
9			4.2	4.6	2.8	3.2					3.0	3.4
10			5.4	4.2	2.8	2.6					2.7	3.3
11			5.6	5.0	2.8	2.6					2.5	3.3
12			5.0	5.2	2.8	3.1					2.7	3.1
13			4.4	4.7	3.0	3.0					3.0	3.3
14			4.0	4.2	2.6	3.2					2.8	3.3
15			3.8	3.8	3.4	3.9					2.6	3.2
16			4.2	3.0	3.0	3.5					2.6	3.3
17			4.0	3.5	3.0	3.1					2.7	3.2
18			4.3	3.9	2.9	3.2					3.1	3.3
19			5.8	3.4	3.0	3.1					2.7	3.3
20			6.8	3.4	2.8	4.7					2.6	3.2
21			6.6	3.6	2.8	4.4					2.6	3.4
22			6.8	4.0	3.2	3.7					2.5	3.8
23			6.0	3.8	2.9	3.2					2.4	4.0
24			5.1	3.6	3.0	3.3					2.8	4.3
25			6.9	3.4	2.8	3.2					3.0	3.8
26			7.1	3.0	2.9	3.1					2.5	3.4
27			7.0	3.2	2.5	2.8					2.5	3.4
28			6.8	3.4	2.4	3.0					2.5	3.5
29			7.0	3.1	2.8	2.9					2.6	3.7
30			6.5	3.2	2.4	2.6					2.7	5.1
31			5.4		2.8							4.2

NOTE.—No gage heights during frozen season. Gage heights omitted from July 1 to October 31, inclusive, not being well determined.

Station rating table for Shetucket River near Willimantic, Conn., from April 4, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	310	3.70	870	4.90	1,720	6.00	2,730
2.60	345	3.80	930	5.00	1,805	6.10	2,830
2.70	385	3.90	990	5.10	1,890	6.20	2,930
2.80	425	4.00	1,055	5.20	1,980	6.30	3,030
2.90	465	4.10	1,120	5.30	2,070	6.40	3,130
3.00	510	4.20	1,190	5.40	2,160	6.50	3,230
3.10	555	4.30	1,260	5.50	2,255	6.60	3,335
3.20	603	4.40	1,330	5.60	2,350	6.70	3,440
3.30	654	4.50	1,405	5.70	2,445	6.80	3,545
3.40	706	4.60	1,480	5.80	2,540	6.90	3,650
3.50	758	4.70	1,560	5.90	2,635	7.00	3,755
3.60	814	4.80	1,640				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1904-5. It is well defined between gage heights 2.5 feet and 6.5 feet. Estimates below gage height 2.5 feet are somewhat uncertain.

Estimated monthly discharge of Shetucket River near Willimantic, Conn., for 1904–5.

[Drainage area, 396 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
April 4–30	4,420	758	1,784	4.50	4.51
May	2,350	385	920	2.32	2.68
June	555	84	326	.823	.918
July	345	84	221	.558	.643
August	930	126	373	.942	1.09
September	2,930	66	428	1.08	1.20
October	930	207	396	1.00	1.15
November	990	150	381	.962	1.07
December 1–17, 28–31	3,755	126	831	2.10	1.64
1905.					
March	3,865	275	1,937	4.89	5.64
April	4,195	510	1,254	3.17	3.54
May	706	275	455	1.15	1.33
June	1,560	66	565	1.43	1.60
November	555	207	364	.919	1.08
December	2,930	555	902	2.28	2.63

NOTE.—River frozen December 18–27, 1904.

CONNECTICUT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Connecticut River has its source in Connecticut Lake in northern New Hampshire. Its extreme headwaters, however, lie in the Province of Quebec and in the mountains on the northern boundary of New Hampshire; thence the river flows in a southerly direction between New Hampshire and Vermont and through Massachusetts and Connecticut into Long Island Sound. The total drainage area is 11,085 square miles, of which 155 square miles lie in the Province of Quebec. Its total length from Connecticut Lake to Long Island Sound is 345 miles. On its banks are many cities and towns of importance. It is in general closely followed by one or more railroad lines. Water power is used at several points, notably at Windsor Locks, Conn.; Holyoke and Turners Falls, Mass.; and Bellows Falls and Wilder, Vt. The valley of Connecticut River proper is very generally in farm lands. Many of its tributary basins, however, especially in the northern portions, are heavily wooded.

The drainage areas of the river and of several of its tributaries are given in the following table:

Drainage areas of Connecticut River and tributaries.

River.	Locality.	Area.
		Sq. miles.
Connecticut	In Canada	155
Do	Orford, N. H., at gaging station	3,305
Do	Sunderland, Mass., at gaging station	7,700
Do	Hartford, Conn	10,235
Do	Mouth	11,085
Israel	Above South Branch, at gaging station	8.7
Do	Below South Branch, at gaging station	21.2
Ammonoosuc	Bretton Woods, N. H., at gaging station	34
Zealand	Mouth and at gaging station	14
Little	At gaging station	11
Do	Mouth	12
White	Sharon, Vt	680
Ashuelot	Winchester, N. H	385
Deerfield	Mouth	667
Do	Deerfield, Mass., at gaging station	550
Chicopee	Mouth	730
Ware	do	223
Do	Gilbertville, Mass	160
Do	Ware, Mass., at gaging station	162
Quaboag	Mouth	213
Do	West Warren, Mass., at gaging station	144
Swift	Mouth	218
Do	West Ware, Mass., at gaging station	188
Westfield	Mouth	518
Do	Russell, Mass., at gaging station	331
Westfield Little	Mouth	83.6
Do	At gaging station, near Blandford, Mass	43.2
Salmon	Mouth	152
Do	At gaging station, Leesville, Conn	115

CONNECTICUT RIVER NEAR ORFORD, N. H.

This station was established August 6, 1900, by E. G. Paul. It is located at the wooden highway bridge between Orford, N. H., and Fairlee, Vt., and is about 75 miles from the source of the stream.

The channel is straight for at least 1,000 feet above and below the station, is about 275 feet wide at ordinary stages of the river, and is broken by one pier. The bed is of gravel and permanent, while the current is strong.

Discharge measurements are made from the bridge.

A standard chain gage, which is read once each day by Frank H. Gardner, is attached to the inside timbers of the upper side of the bridge, 125 feet from the left abutment. The length of the chain is 42.95 feet. The gage is referred to bench marks as follows: (1) Top of downstream corner of right abutment at face; elevation, 30.34 feet. (2) Chisel draft marked "B. M." in base of downstream corner of left abutment at face; elevation, 30.04 feet. (3) Nail in root of elm tree on Orford side, 28.4 feet from southwest corner of bridge and 11.6 feet from produced line of downstream side of bridge; elevation, 39.06 feet. Elevations are above datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 47, p 34; 65, p 29; 82, p 46; 97, p 81; 124, p 115.
Discharge: 65, p 29; 82, p 47; 97, p 81; 124, p 116.
Discharge, monthly: 75, p 23; 82, p 48; 97, p 84; 124, p 119.
Gage heights: 47, p 34; 65, p 30; 82, p 47; 97, p 82; 124, p 117.
Rating tables: 65, p 318; 97, pp 82–84; 124, pp 118–119.

Discharge measurements of Connecticut River, near Orford, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
February 28[a]	T. W. Norcross	235	775	0.88	4.07	686
March 1[b]	do	235	794	.96	4.26	766
March 1[c]	do	235	794	.93	4.25	739
April 5	A. D. Butterfield	313	3,650	3.15	11.90	11,500
April 6	do	313	3,590	3.04	11.70	10,900
August 30	T. W. Norcross	282	1,770	1.68	5.62	2,980

[a] Gage height to top of ice, 4.22 feet. Ice, 2.05 feet thick at gage. Average distance from bottom of ice to water surface, 1.77 feet. Average thickness of ice, 2.01 feet.
[b] Gage height to top of ice, 4.40 feet. Ice, 2.1 feet thick at gage. Average distance from bottom of ice to water surface, 1.86 feet. Average thickness of ice, 2.09 feet.
[c] Gage height to top of ice, 4.40 feet. Ice, 2.1 feet thick at gage.

Daily gage height, in feet, of Connecticut River near Orford, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	.....	.....	23.0	12.8	6.9	8.7	6.2	8.8	5.8	4.4	9.0
2	.....	.....	.....	22.0	12.5	6.7	9.1	7.4	7.8	5.7	4.5	10.1
3	.....	.....	.....	18.4	10.9	6.2	11.4	9.3	6.6	5.4	4.4	10.9
4	.....	.....	.....	14.2	11.2	6.3	15.5	7.7	8.7	5.4	4.5	11.4
5	.....	4.2	4.2	12.0	12.4	6.5	14.2	6.8	9.6	5.2	4.7	12.0
6	.....	.....	.....	11.8	12.8	6.6	11.1	5.6	9.2	5.1	5.6	11.2
7	.....	.....	.....	13.2	13.0	7.6	7.2	5.1	8.4	5.0	6.1	11.0
8	3.9	.....	.....	13.0	12.8	7.0	6.4	5.1	7.8	4.8	6.5	10.8
9	.....	.....	.....	12.4	12.3	6.8	6.0	5.6	7.1	4.7	6.3	10.2
10	.....	.....	.....	11.0	11.2	6.2	5.8	5.9	6.5	4.6	6.2	8.4
11	.....	.....	.....	11.3	11.6	5.8	5.5	5.1	5.8	4.5	6.0	7.8
12	.....	4.5	4.3	12.7	11.3	5.4	5.2	5.3	5.5	4.5	5.9	6.6
13	.....	.....	.....	13.3	10.0	6.0	5.3	4.9	5.7	5.4	5.6	6.5
14	.....	.....	.....	13.2	9.7	7.6	5.2	5.0	5.6	5.7	5.6	6.4
15	4.7	.....	.....	13.0	9.5	8.1	5.0	5.1	5.4	5.7	5.5	6.4
16	.....	.....	.....	12.6	9.2	7.4	5.1	5.9	5.1	5.5	5.3	6.4
17	.....	.....	.....	11.6	9.0	7.0	5.2	8.3	5.0	5.2	5.5	6.6
18	.....	.....	.....	10.6	9.2	5.7	5.1	8.4	6.6	4.9	5.6	6.1
19	.....	4.4	5.0	9.6	9.1	5.8	5.1	7.5	10.6	4.9	5.4	5.6
20	.....	.....	6.4	9.1	9.0	6.1	6.4	6.4	11.4	5.0	5.5	5.8
21	.....	.....	7.6	11.8	9.0	5.9	6.5	5.6	11.4	5.3	5.6	6.1
22	4.4	.....	8.1	13.6	8.9	6.0	6.1	5.1	11.0	5.6	5.7	6.6
23	.....	.....	8.2	14.2	8.6	6.0	5.0	4.8	9.8	5.5	5.9	7.0
24	.....	.....	8.3	13.4	8.0	5.9	4.6	4.4	8.4	5.6	5.3	7.1
25	.....	.....	9.9	12.0	7.4	5.5	4.3	3.9	8.0	5.4	4.9	7.0
26	.....	4.3	16.4	11.0	7.1	5.1	3.9	3.6	7.0	5.0	5.1	7.0
27	.....	.....	19.0	10.9	6.6	5.9	3.9	3.6	6.9	4.6	5.4	6.9
28	.....	.....	22.4	11.5	8.7	9.2	3.8	4.6	6.5	4.6	5.5	6.8
29	4.3	.....	24.8	12.2	9.1	9.4	3.8	6.2	6.2	4.6	6.2	7.0
30	.....	.....	24.8	12.8	8.4	8.2	3.7	5.9	6.0	4.6	8.1	7.1
31	.....	.....	24.0	.....	7.1	.....	6.0	6.9	.....	4.2	.....	8.4

NOTE.—River frozen January 1 to March 25 and November 30 to December 5. During frozen season gage heights were read to the surface of the water in a hole cut in the ice, except March 19–25, when readings were taken to top of ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 1	4.1	4.2	1.3	February 12	4.5	4.5	2.1
January 8	3.9	4.0	1.5	February 19	4.4	4.5	1.9
January 15	4.7	4.8	1.5	February 26	4.3	4.6	2.2
January 22	4.4	4.6	1.6	March 5	4.2	4.4	2.2
January 29	4.3	4.5	1.7	March 12	4.3	4.4	2.1
February 5	4.2	4.4	2.1	March 19–25	.....	.....	1.6

March 26, river clear of ice. November 30, river frozen over; ice 0.1 foot thick. December 5, river clear of ice.

Station rating table for Connecticut River near Orford, N. H., from March 29 to November 16, 1904, and from March 26 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	640	3.80	1,600	5.60	3,070	8.80	6,640
2.10	680	3.90	1,670	5.70	3,170	9.00	6,900
2.20	725	4.00	1,740	5.80	3,270	9.20	7,160
2.30	770	4.10	1,810	5.90	3,370	9.40	7,420
2.40	815	4.20	1,880	6.00	3,470	9.60	7,690
2.50	860	4.30	1,950	6.20	3,680	9.80	7,970
2.60	905	4.40	2,030	6.40	3,900	10.00	8,250
2.70	950	4.50	2,110	6.60	4,120	10.20	8,530
2.80	1,000	4.60	2,190	6.80	4,340	10.40	8,810
2.90	1,050	4.70	2,270	7.00	4,560	10.60	9,100
3.00	1,100	4.80	2,350	7.20	4,780	10.80	9,400
3.10	1,160	4.90	2,430	7.40	5,000	11.00	9,700
3.20	1,220	5.00	2,520	7.60	5,220	11.20	10,000
3.30	1,280	5.10	2,610	7.80	5,440	11.40	10,300
3.40	1,340	5.20	2,700	8.00	5,660	11.60	10,600
3.50	1,400	5.30	2,790	8.20	5,900	11.80	10,900
3.60	1,460	5.40	2,880	8.40	6,140	12.00	11,200
3.70	1,530	5.50	2,970	8.60	6,380		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900–1905. It is well defined between gage heights 2 feet and 12 feet. Above gage height 12 feet the rating curve is a tangent, the difference being 157 per tenth. Two estimated and one measured discharges are used as the basis for extending the curve above gage height 12 feet.

Estimated monthly discharge of Connecticut River near Orford, N. H., for 1905.

[Drainage area, 3,305 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	28,470	7,030	12,880	3.90	4.35
May	12,770	4,120	8,340	2.52	2.90
June	7,420	2,610	4,179	1.26	1.41
July	16,700	1,530	4,334	1.31	1.51
August	7,290	1,460	3,426	1.04	1.20
September	10,300	2,520	5,392	1.63	1.82
October	3,270	1,880	2,622	.793	.914
November[a]	5,780	2,030	3,068	.928	1.04

[a] No correction made in discharge November 30 for ice conditions.

CONNECTICUT RIVER AT SUNDERLAND, MASS.

This station was established March 31, 1904, by N. C. Grover. It is located at a five-span steel highway bridge, with a total length of about 830 feet, at Sunderland. The nearest railway station is at South Deerfield. The gaging station is about 18 miles above the dam at Holyoke and about 5 miles below that at Turners Falls.

The channel is straight for 1,000 feet above and below the station. Both banks are high, rocky, and wooded, and not subject to overflow. The bed of the stream is of gravel, clean and permanent. There are five channels at all stages. The current is swift at high and medium at low stages.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the left abutment at the top on the downstream side.

A standard chain gage, which is read twice each day by V. Lawer, is attached to the downstream side of the bridge near the left bank. The length of the chain was 42.79 feet when established, but changed to 42.93 feet September 1, 1905, owing to movement of bridge. The gage is referred to bench marks as follows: (1) On the bottom chord of the bridge directly under the downspout of gage; elevation, 37.81 feet; (2) corner of left bridge seat at the top of the downstream face; elevation, 37.06 feet; (3) northwest corner of the coping of the downstream end of the pipe culvert, 250 feet east from the left end of the bridge; elevation, 32.91 feet. All elevations are above the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 120–121.

Discharge measurements of Connecticut River at Sunderland, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 3	T. W. Norcross	787	15,400	3.94	20.11	60,600
April 6	do	777	11,600	3.84	15.26	44,600
April 14	do	775	11,100	3.75	14.57	41,600
April 27	do	744	6,970	3.27	9.28	22,800
May 18	do	736	5,510	2.92	7.67	16,100
August 18	do	731	5,410	2.72	7.46	14,700
September 1	do	697	3,390	2.14	4.75	7,240
September 9	do	738	5,620	2.77	8.01	15,600

Daily gage height, in feet, of Connecticut River at Sunderland, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	27.25	9.3	5.3	6.35	10.55	4.7	5.4	4.2	7.45
2	.....	.....	.....	28.75	9.35	4.9	5.6	9.1	5.85	5.1	4.2	6.35
3	.....	.....	.....	19.95	9.1	4.55	4.8	7.95	7.7	5.2	4.2	6.8
4	.....	4.35	4.75	17.35	8.85	4.35	6.9	7.5	12.4	5.0	4.4	13.3
5	.....	.....	.....	15.45	8.6	4.3	9.3	6.55	14.55	4.9	4.7	11.6
6	.....	.....	.....	15.45	8.75	4.6	9.2	5.45	12.7	4.7	4.9	9.9
7	.....	.....	.....	16.45	9.0	4.7	7.9	4.95	10.8	4.5	5.55	8.75
8	.....	.....	.....	15.05	9.05	5.4	6.55	4.9	9.35	4.3	6.5	7.9
9	.....	.....	.....	13.35	8.9	5.7	5.55	4.55	8.2	4.05	6.3	7.35
10	.....	.....	.....	12.45	8.6	5.4	4.9	4.3	7.15	4.2	5.9	6.85
11	.....	4.85	.....	13.65	8.4	4.95	4.7	4.5	6.4	4.15	5.6	6.6
12	.....	.....	.....	16.3	8.05	4.5	4.3	5.25	6.6	4.3	5.4	5.95
13	.....	.....	.....	15.95	7.8	4.5	4.1	5.25	8.0	5.2	5.1	6.0
14	6.75	.....	.....	14.55	7.55	4.8	4.0	5.0	7.8	5.45	5.2	5.65
15	.....	.....	.....	13.55	7.2	5.15	3.8	4.75	6.85	5.3	5.15	6.2
16	.....	.....	.....	12.55	7.3	5.4	3.65	4.9	6.1	4.95	5.1	7.05
17	.....	.....	.....	11.65	7.8	5.35	3.5	6.55	5.65	4.95	5.0	6.85
18	.....	4.9	.....	10.7	7.3	4.9	3.7	7.55	5.7	4.7	4.9	6.7
19	.....	.....	.....	9.8	7.65	4.5	3.7	7.0	13.75	4.6	4.85	6.55
20	.....	.....	.....	9.05	7.25	4.6	3.9	6.15	13.8	4.8	4.7	6.7
21	5.4	.....	.....	8.7	6.9	4.95	4.1	5.45	12.5	5.45	4.5	6.7
22	.....	.....	.....	9.4	6.6	7.3	4.1	4.95	12.2	5.65	4.2	7.3
23	.....	.....	.....	10.55	6.55	7.75	4.0	4.45	10.55	5.3	4.1	7.6
24	.....	.....	.....	11.0	6.3	6.75	3.6	4.05	9.2	5.35	4.1	7.5
25	.....	4.7	.....	10.7	6.0	5.7	3.6	3.9	8.0	5.15	4.2	6.95
26	.....	.....	.....	10.0	5.4	5.25	3.4	3.65	7.25	4.9	4.1	6.55
27	.....	.....	19.45	9.35	5.15	5.65	3.3	3.55	6.65	4.8	4.1	6.5
28	5.1	.....	22.5	9.0	4.9	5.65	3.3	3.4	6.3	4.55	4.35	6.3
29	.....	.....	22.45	8.85	5.3	6.2	3.2	3.3	6.0	4.3	4.6	6.35
30	.....	.....	25.05	9.0	5.95	6.7	3.2	3.65	5.75	4.1	7.45	7.5
31	.....	.....	26.95	.....	5.7	.....	6.0	4.55	.....	4.1	.....	8.05

NOTE.—River frozen January 1 to March 26. During this period gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 7	.....	6.6	(a)	February 25	4.7	4.8	1.5
January 14	6.75	6.6	1.0	March 4	4.75	4.85	1.7
January 21	5.4	5.5	1.15	March 11	.....	5.45	(b)
January 28	5.1	5.2	1.05	March 18	.....	5.5	(a)
February 4	4.35	4.4	1.4	March 25	.....	9.75	(c)
February 11	4.85	4.75	1.55	March 26	.....	14.75	.....
February 18	4.9	5.0	1.65				

a Ice broken up along banks. b Ice thin near banks. c Ice beginning to break up.

March 27, river clear of ice. Highest point April 1 in morning was 27.7 feet.

Station rating table for Connecticut River at Sunderland, Mass., from April 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	2,250	3.50	5,380	5.30	9,670	7.10	15,080
1.80	2,370	3.60	5,610	5.40	9,980	7.20	15,370
1.90	2,500	3.70	5,840	5.50	10,200	7.30	15,710
2.00	2,630	3.80	6,070	5.60	10,470	7.40	16,060
2.10	2,770	3.90	6,300	5.70	10,750	7.50	16,410
2.20	2,910	4.00	6,530	5.80	11,030	7.60	16,760
2.30	3,060	4.10	6,760	5.90	11,310	7.70	17,110
2.40	3,210	4.20	6,990	6.00	11,600	7.80	17,470
2.50	3,370	4.30	7,220	6.10	11,890	7.90	17,830
2.60	3,540	4.40	7,460	6.20	12,190	8.00	18,190
2.70	3,720	4.50	7,700	6.30	12,490	8.10	18,550
2.80	3,900	4.60	7,940	6.40	12,790	8.20	18,920
2.90	4,080	4.70	8,180	6.50	13,100	8.30	19,290
3.00	4,280	4.80	8,420	6.60	13,410	8.40	19,660
3.10	4,490	4.90	8,660	6.70	13,730	8.50	20,030
3.20	4,710	5.00	8,910	6.80	14,050		
3.30	4,930	5.10	9,160	6.90	14,370		
3.40	5,150	5.20	9,410	7.00	14,700		

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 2.3 feet and 18 feet. Above gage height 8.5 feet the rating curve is a tangent, the difference being 380 per tenth.

Station rating table for Connecticut River at Sunderland, Mass., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	3,110	4.50	6,670	6.30	11,480	8.10	17,280
2.80	3,270	4.60	6,900	6.40	11,780	8.20	17,630
2.90	3,430	4.70	7,140	6.50	12,080	8.30	17,980
3.00	3,600	4.80	7,380	6.60	12,380	8.40	18,330
3.10	3,770	4.90	7,630	6.70	12,690	8.50	18,680
3.20	3,950	5.00	7,880	6.80	13,000	8.60	19,030
3.30	4,130	5.10	8,140	6.90	13,310	8.70	19,390
3.40	4,320	5.20	8,400	7.00	13,620	8.80	19,750
3.50	4,520	5.30	8,660	7.10	13,940	8.90	20,110
3.60	4,720	5.40	8,930	7.20	14,260	9.00	20,470
3.70	4,920	5.50	9,200	7.30	14,580	9.10	20,830
3.80	5,130	5.60	9,470	7.40	14,910	9.20	21,190
3.90	5,340	5.70	9,750	7.50	15,240	9.30	21,550
4.00	5,550	5.80	10,030	7.60	15,570	9.40	21,910
4.10	5,770	5.90	10,310	7.70	15,910	9.50	22,270
4.20	5,990	6.00	10,600	7.80	16,250	9.60	22,630
4.30	6,210	6.10	10,890	7.90	16,590	9.70	22,990
4.40	6,440	6.20	11,180	8.00	16,930	9.80	23,360

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1905. It is fairly well defined. Above gage height 9.8 feet the rating curve is a tangent, the difference being 370 per tenth.

Estimated monthly discharge of Connecticut River at Sunderland, Mass., for 1904.

[Drainage area, 7,700 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	69,050	22,880	38,730	5.03	5.61
May	62,210	14,210	31,600	4.10	4.73
June	18,190	4,080	8,102	1.05	1.17
July	7,820	2,500	4,528	.588	.678
August	9,285	2,310	5,124	.665	.767
September	20,790	3,135	8,546	1.11	1.24
October	26,490	8,180	13,400	1.74	2.01
November	10,610	5,725	7,506	.975	1.09
December 1-10[a]	10,200	7,700	8,468	1.10	.409

[a] River frozen December 11 to 31.

Estimated monthly discharge of Connecticut River near Sunderland, Mass., for 1905.

[Drainage area, 7,700 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 27-31	86,820	59,060	73,240	9.51	1.77
April	87,920	19,390	36,540	4.75	5.30
May	21,730	7,630	15,330	1.99	2.29
June	16,080	6,210	8,852	1.15	1.28
July	21,550	3,950	7,814	1.01	1.16
August	26,140	4,130	9,397	1.22	1.41
September	40,940	7,140	19,580	2.54	2.83
October	9,610	5,660	7,475	.971	1.12
November	15,080	5,770	7,797	1.01	1.13
December	36,310	9,610	14,960	1.94	2.24

CONNECTICUT RIVER AT HARTFORD, CONN.

Daily readings of the height of water at Hartford have been recorded since February 8, 1896, by Edwin Dwight Graves, chief engineer of the Connecticut River bridge and highway district, and through his courtesy have been furnished to the United States Geological Survey.

These heights are read on what is known as the toll-house gage, the zero of which is set at the low-water mark of 1801.[a] The highest water ever known in the river (29 feet 10 inches) was in May, 1854; the lowest (1½ inches below zero) in 1858.

This datum was used in the various surveys of the river below Hartford in 1866–67;[a] also in the survey above Hartford in 1871–1878,[b] and in the survey of 1897.[c] It has

[a] See report of Theodore G. Ellis, 1867 (H. R. Ex. Doc. No. 153, 40th Cong., 2d sess.).
[b] Engineers Report, 1878, pp. 348–391.
[c] Engineers' Report, 1898, pp. 976–988.

again been used, 1902–1905, in a further survey by the Secretary of War to study the problem of river improvements above Hartford.

During low-water periods the tidal wave comes up the river to Hartford. The visible effect of this wave is dependent on the height of the water and the direction and course of the wind.

From figures given in the Report of the Chief of Engineers for 1878, pages 348–391, and from other data, computations of the discharge of Connecticut River at Hartford from 1871 to 1886, inclusive, were prepared and published as per references below.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: Ann 20, iv, pp 77–78; WS 35, p 42; 47, p 35; 65, p 30; 82, pp 48–49; 97, pp 84–85; 124, pp 121–122.

Discharge, monthly: Ann 14, ii, pp 141–144.

Discharge, yearly: Ann 20, iv, p 47.

Gage heights: WS 35, pp 43–44; 47, p 35; 65, p 31; 82, p 49; 97, p 85; 124, p 122.

Daily gage height, in feet, of Connecticut River at Hartford, Conn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	3.7	3.3	24.0	7.1	3.8	4.2	4.6	2.5	3.8	2.9	5.5
2	4.0	3.4	3.2	24.1	7.2	3.4	4.0	7.1	2.9	3.5	2.3	5.3
3	4.9	3.1	3.0	22.2	7.2	3.0	3.3	6.0	4.0	3.4	2.6	4.3
4	4.7	3.2	3.1	19.5	7.0	2.5	2.8	5.2	8.6	3.4	3.0	9.0
5	4.0	2.4	2.5	17.1	6.7	2.6	4.6	4.8	13.7	3.4	2.5	11.1
6	3.4	2.2	1.8	15.9	6.5	3.0	6.2	4.0	13.4	3.1	3.3	9.4
7	5.0	3.6	3.0	16.2	6.6	2.9	6.0	3.4	11.4	3.0	3.4	7.9
8	10.6	3.0	3.3	15.8	6.6	3.0	5.2	3.1	9.2	3.0	4.6	6.8
9	11.7	3.2	3.4	14.3	7.0	3.8	4.0	3.0	7.5	2.6	4.4	6.0
10	10.0	3.6	4.1	12.6	6.5	3.9	3.6	2.9	6.0	3.3	4.0	5.6
11	8.0	3.0	5.3	11.7	6.3	3.5	3.2	2.9	5.2	3.1	3.6	4.5
12	7.0	2.6	5.0	13.5	6.1	3.6	3.1	2.8	5.1	3.3	3.5	4.6
13	7.0	3.1	4.9	14.8	6.0	3.8	3.0	2.6	5.5	2.9	3.1	4.4
14	6.8	3.5	5.2	14.4	5.8	3.4	2.6	2.8	6.3	3.1	3.0	4.1
15	5.7	3.2	5.0	13.1	5.6	3.1	2.7	3.0	5.7	3.2	3.1	3.0
16	5.0	3.1	4.4	12.0	5.6	3.3	1.6	3.0	5.0	3.1	3.3	3.8
17	4.8	3.0	4.1	11.0	5.6	3.3	1.7	3.2	4.1	3.0	3.2	4.2
18	4.4	3.0	4.3	10.0	5.9	3.1	2.1	4.2	4.0	2.9	3.0	4.4
19	4.6	2.3	5.1	9.1	6.0	2.9	2.2	4.8	4.5	3.0	2.5	4.7
20	4.6	1.5	8.2	8.4	5.8	3.3	2.3	4.3	10.6	3.1	2.8	4.5
21	4.4	3.2	9.6	7.7	5.3	3.0	2.0	3.7	10.6	3.2	2.9	5.0
22	3.9	3.4	7.6	7.6	4.9	3.6	2.3	3.3	9.9	3.4	2.9	5.5
23	3.8	3.8	7.5	8.0	5.0	5.7	2.0	3.0	9.2	4.0	2.7	5.6
24	4.3	3.8	7.4	8.7	4.8	5.7	2.4	2.7	7.8	4.0	3.2	5.2
25	4.3	3.6	7.4	9.1	4.5	4.6	2.5	2.9	6.5	3.8	3.2	4.5
26	3.9	3.4	10.6	8.8	4.1	4.0	2.3	3.0	5.6	3.6	2.1	4.4
27	3.4	2.2	13.2	8.2	3.7	3.7	2.3	2.4	5.0	3.7	2.2	4.2
28	3.6	3.2	16.7	7.6	3.4	3.6	2.3	2.5	4.5	3.1	2.3	3.8
29	3.3	.....	19.5	7.2	3.3	3.5	1.4	2.7	4.2	2.3	3.0	4.4
30	3.3	.....	20.9	7.0	3.4	4.0	2.5	2.5	4.0	2.4	3.0	4.8
31	3.9	.....	22.6	.....	4.0	.....	3.4	2.3	.....	2.8	.....	4.5

ISRAEL RIVER (ABOVE SOUTH BRANCH) NEAR JEFFERSON HIGHLANDS, N. H.

This station was established September 2, 1903, by N. C. Grover. It is located at a small wooden highway bridge in the town of Randolph, about halfway between the railway stations of Jefferson Highlands and Bowman, 2½ miles from either place. The headwaters of the river lie on the slopes of Mount Adams and Mount Jefferson, at elevations approximating 5,000 feet. The length of the river from its source to the gaging station is about 5 miles. The elevation at the gaging station is about 1,400 feet. All slopes are steep; many are precipitous. There is no pondage or artificial storage of water. The underlying rock is granite, exposed in the mountain tops. The basin is generally in heavy virgin forest.

The channel is straight for 100 feet above and 50 feet below the station, and is about 20 feet wide. The banks are subject to overflow in extreme freshets. The current is strong at high and medium at low stages. The bed is gravelly and permanent.

Discharge measurements at high and ordinary stages are made from the bridge. Low-water measurements are made by wading about 20 feet above the bridge.

A standard chain gage, which is read once each day by E. A. Crawford, is attached to the upstream truss of the bridge. The length of the chain is 15.43 feet. The gage is referred to bench marks as follows: (1) Marked point on east end of cross timber of bridge; elevation, 8.58 feet. (2) Top of bowlder 150 feet east of bridge, 30 feet south of river; elevation, 12.10 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 86; 124, p 123.
Discharge: 97, p 86; 124, p. 123.
Discharge, monthly: 124, p 125.
Gage heights: 97, p 87; 124, p 124.
Rating table: 124, p 124.

Discharge measurements of Israel River (above South Branch) near Jefferson Highlands, N. H., in 1905.

Date.	Hydrograper.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 5	T. W. Norcross	22	35	1.69	1.92	60
August 3	do	23	29	1.34	1.73	39
August 24 [a]	do	21.5	12	.87	1.27	10.5
October 26 [b]	do	21	11.6	1.09	1.29	12.7

[a] By wading; meter on a rod.

[b] By wading.

Daily gage height, in feet, of Israel River (above South Branch) near Jefferson Highlands, N. H., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.9	1.4	1.4	1.75	1.5	1.2	1.25
2	1.35	1.85	2.25	1.45	1.75	1.45	1.2	1.25
3	1.3	1.7	1.85	3.3	1.7	1.45	1.2	1.25
4	2.7	1.6	1.65	2.7	1.6	1.45	1.2	1.25
5	1.9	1.5	1.55	2.4	1.85	1.45	1.3	2.15
6	1.85	1.6	1.5	2.0	1.8	1.4	1.3	2.1
7	1.9	1.5	1.45	1.8	1.75	1.4	1.3	1.85
8	1.6	1.7	1.4	1.8	1.75	1.4	1.3	1.8
9	1.55	1.65	1.35	2.3	1.8	1.4	1.3	1.75
10	1.85	1.55	1.3	1.7	1.7	1.35	1.3	1.65
11	1.7	1.7	1.25	1.5	1.6	1.35	1.35	1.55
12	1.6	1.95	1.25	1.5	1.55	1.55	1.3	1.6
13	1.7	1.75	1.45	1.7	1.55	1.5	1.25	1.55
14	1.65	1.65	1.4	1.5	1.65	1.5	1.25	1.5
15	1.65	1.55	1.4	1.45	1.65	1.45	1.25	1.4
16	1.9	1.5	1.35	1.4	1.6	1.45	1.2	1.35
17	1.6	1.45	1.45	1.4	1.55	1.4	1.2	.....
18	1.85	1.45	1.4	1.35	2.5	1.4	1.55	.....
19	1.8	1.65	1.35	1.3	2.1	1.65	1.5	.....
20	1.75	1.5	1.3	1.25	1.95	1.6	1.4	.....
21	1.7	1.45	1.25	1.25	1.7	1.5	1.4	.....
22	1.75	1.4	1.2	1.35	1.65	1.4	1.35	.....
23	1.65	1.35	1.2	1.4	1.6	1.75	1.35	.....
24	1.5	1.3	1.2	1.45	1.55	1.35	1.3	.....
25	1.5	1.3	1.2	1.4	1.8	1.35	1.3	.....
26	1.95	1.9	1.35	1.35	1.75	1.3	1.3	.....
27	2.3	1.75	1.3	1.4	1.7	.....	1.25	.....
28	2.45	1.65	1.35	1.45	1.6	.....	1.3	.....
29	2.05	1.5	1.3	1.4	1.55	.....	1.3	.....
30	1.8	1.45	1.3	1.35	1.55	.....	1.25	.....
31	1.65	.....	1.35	1.3	.....	.....	.....	.....

NOTE.—River frozen January 1 to April 30 and December 17-31. Gage heights are somewhat unreliable owing to carelessness of gage reader.

Station rating table for Israel River (above South Branch) near Jefferson Highlands, N. H., from September 2, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	1.0	1.30	13	1.80	46	2.20	93
0.90	1.6	1.40	18	1.90	55	2.30	108
1.00	3.0	1.50	24	2.00	67	2.40	124
1.10	5.3	1.60	30	2.10	79	2.50	140
1.20	8.6	1.70	38				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-5. It is fairly well defined between gage heights 1.04 feet and 2.4 feet. Above 2.5 feet the curve is a tangent, the difference being 18 per tenth.

Estimated monthly discharge of Israel River (above South Branch) near Jefferson Highlands, N. H., for 1905.

[Drainage area, 8.7 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	176	13	48.4	5.56	6.41
June	61	13	31.1	3.57	3.98
July	100	8.6	19.6	2.25	2.59
August	284	10.5	42.5	4.89	5.64
September	140	27	41.5	4.77	5.32
October[a]	34	8.6	18.7	2.15	2.48
November	27	8.6	13.1	1.51	1.68
December 1-16	86	10.5	32.5	3.74	2.22

[a] Discharge interpolated October 27-31.

ISRAEL RIVER (BELOW SOUTH BRANCH) NEAR JEFFERSON HIGHLANDS, N. H.

This station was established September 2, 1903, by N. C. Grover. It is located at a small wooden highway bridge about 2 miles from the railway station at Jefferson Highlands, in the town of Jefferson. South Branch of Israel River has its mouth above this station and below the station previously described (p. 123). South Branch drains an area of 10.5 square miles; its headwaters are on the slopes of Mount Jefferson and Mount Dartmouth, at elevations of 3,000 to 5,000 feet. The extreme length from its source to its mouth is about 5 miles. The elevation at its mouth is about 1,350 feet. As all the slopes are steep there is little or no storage of water. The underlying rock is granite, exposed in the mountain peaks. The basin has been generally "hard cut," as the lumbermen say, but has not been burned.

The channel is straight for 100 feet above and below the station, and is about 20 feet wide. The bed is rough and rocky, but permanent. The banks are subject to overflow in extreme freshets. The current is strong at high and well sustained at low stages.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the right abutment of the bridge.

A standard chain gage, which is read once each day by E. A. Crawford, is attached to the downstream truss of the bridge; length of chain, 12.99 feet. The gage is referred to bench marks, as follows: (1) Marked point on center cross timber of bridge; elevation, 8.14 feet. (2) Top of bowlder 50 feet north of bridge, 15 feet west of highway; elevation, 5.20 feet. Elevations are above datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 87; 124, pp 125-126.
Discharge: 97, p 88; 124, p 126.
Discharge, monthly: 124, p 128.
Gage heights: 97, p 88; 124, p 127.
Rating table: 124, p 127.

Discharge measurements of Israel River (below South Branch) near Jefferson Highlands, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 5 [a]	T. W. Norcross	41	43.9	3.01	1.94	132
August 3	do	19	23.1	2.81	1.60	65
August 23	do	15	15.8	1.30	1.20	20.6
August 24 [b]	do	20	18.0	1.18	1.20	21.3
October 26	do	16	16.4	1.36	1.23	22.3

[a] Measurement made from downstream side of bridge.
[b] By wading about 40 feet above bridge; meter on a rod.

Daily gage height, in feet, of Israel River (below South Branch) near Jefferson Highlands, N. H., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.9	1.4	1.45	1.7	1.45	1.15	1.2
2	1.35	1.8	2.15	1.45	1.7	1.4	1.15	1.2
3	1.3	1.7	1.8	2.9	1.6	1.4	1.15	1.2
4	2.7	1.6	1.6	2.7	1.5	1.4	1.15	1.2
5	1.95	1.5	1.55	2.4	1.8	1.4	1.25	2.0
6	1.85	1.6	1.5	2.4	1.8	1.35	1.25	2.1
7	1.95	1.5	1.45	2.2	1.7	1.35	1.2	1.8
8	1.6	1.7	1.4	2.0	1.65	1.35	1.2	1.7
9	1.5	1.6	1.35	2.5	1.7	1.3	1.2	1.6
10	1.85	1.5	1.35	2.0	1.6	1.3	1.2	1.5
11	1.75	1.7	1.3	1.8	1.55	1.3	1.25	1.5
12	1.65	1.9	1.25	1.7	1.5	1.5	1.25	1.6
13	1.75	1.75	1.5	1.6	1.5	1.45	1.2	1.5
14	1.7	1.65	1.45	1.6	1.6	1.45	1.2	1.45
15	1.7	1.55	1.45	1.55	1.6	1.4	1.2	1.4
16	1.95	1.45	1.4	1.5	1.5	1.4	1.15	1.35
17	1.75	1.45	1.45	1.45	1.5	1.35	1.15	.....
18	1.85	1.5	1.4	1.4	2.3	1.35	1.35	.....
19	1.8	1.6	1.35	1.35	2.0	1.55	1.35	.....
20	1.75	1.5	1.3	1.3	1.8	1.5	1.35	.....
21	1.7	1.45	1.25	1.3	1.65	1.5	1.35	.....
22	1.75	1.45	1.25	1.35	1.6	1.4	1.3	.....
23	1.65	1.4	1.2	1.45	1.55	1.3	1.3	.....
24	1.5	1.35	1.2	1.4	1.5	1.3	1.25	.....
25	1.5	1.35	1.2	1.35	1.7	1.3	1.25	.....
26	1.9	1.95	1.4	1.3	1.7	1.25	1.25	.....
27	2.2	1.8	1.35	1.35	1.6	.....	1.2	.....
28	2.45	1.65	1.35	1.4	1.56	.....	1.25	.....
29	2.0	1.55	1.3	1.35	1.5	.....	1.25	.....
30	1.8	1.45	1.3	1.3	1.5	.....	1.2	.....
31	1.7	.....	1.35	1.25	.....	.....	.....	.....

NOTE.—River frozen January 1 to April 30 and December 17-31. Gage heights are somewhat unreliable, owing to carelessness of gage reader.

Station rating table for Israel River (below South Branch) near Jefferson Highlands, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	10	1.50	51	2.00	154	2.50	298
1.10	15	1.60	66	2.10	182	2.60	327
1.20	21	1.70	84	2.20	211	2.70	356
1.30	29	1.80	105	2.30	240	2.80	385
1.40	39	1.90	128	2.40	269	2.90	414

NOTE.—The above table is applicable only for open-channel conditions. It is based on 21 discharge measurements made during 1903–1905. It is well defined between gage heights 0.9 foot and 2.6 feet.

Estimated monthly discharge of Israel River (below South Branch) near Jefferson Highlands, N. H., for 1905.

[Drainage area, 21.2 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	356	29	109	5.14	5.93
June	141	34	69.0	3.25	3.63
July	196	21	43.9	2.07	2.39
August	414	25	102	4.81	5.54
September	240	51	78.0	3.68	4.11
October[a]	58	18	35.3	1.67	1.92
November	34	18	33.7	1.59	1.77
December 1-16	182	21	63.2	2.98	1.77

[a] Discharge interpolated October 27-31.

AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

This station was established August 28, 1903, by N. C. Grover. It is located at the steel highway bridge near Mount Pleasant House, at Bretton Woods. The drainage area at this point is 34 square miles. The headwaters of the river come from the westerly slopes of Mount Jefferson and Mount Washington and the lesser peaks of the White Mountains lying to the south. The underlying rock is granite, which is exposed at points in the river bed and on the various mountain summits. The slopes and valleys are usually well forested, with a preponderance of evergreen growth. The area was cut in large part for spruce several years ago, but now has a thick forest cover. There is no pondage or artificial storage. The slope of the river is steep.

The channel is straight for 300 feet above and 200 feet below the measuring section, and is about 35 feet wide. The banks are high and not subject to overflow except in extreme freshet. The bed is somewhat rocky, but permanent. The current is medium at ordinary and sluggish at low stages.

Discharge measurements at high and ordinary stages are made from a footbridge located about 300 feet downstream from the highway bridge. Low-water measurements are made by wading at various sections in the vicinity where better velocities are found.

A standard chain gage, which is read twice each day by John Paige, is attached to the floor on the downstream side of the highway bridge; length of chain, 18.86 feet. The gage is referred to the following bench marks: (1) Marked point on bridge near gage; elevation, 17.36 feet when established, but changed to 17.33 feet August 24, 1905. (2) Northwest corner of east abutment; elevation, 14.46 feet. (3) Top of bowlder 100 feet below bridge, between the river and tracks of Boston and Maine Railroad; elevation, 17.11 feet when established, but found to be 17.04 feet August 24, 1905. Elevations are above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 89-90; 124, pp 129.
Discharge: 97, p 90; 124, p 129.
Discharge, monthly: 124, p 131.
Gage heights: 97, p 90; 124, p 130.
Rating table: 124, p 130.

Discharge measurements of Ammonoosuc River at Bretton Woods, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 4	T. W. Norcross	40	157	3.40	3.61	534
July 5	Murphy and Barrows	38	83	.65	1.80	54
August 1 [a]	T. W. Norcross	40	106	1.22	2.40	129
August 4	do	39	89	.70	1.93	62
August 24 [b]	do	30	27.6	1.14	1.58	31.6
October 27 [c]	do	24	28.5	1.07	1.57	30.4

[a] Meter in poor condition.
[b] By wading 150 feet above gage, meter on a rod.
[c] From upstream side of highway bridge.

Daily gage height, in feet, of Ammonoosuc River at Bretton Woods, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				2.72	2.52	1.92	1.75	2.48	2.1	1.72	1.62	1.95
2				2.28	2.38	1.85	2.18	2.0	2.0	1.7	1.6	1.9
3				2.15	2.35	2.28	2.2	2.1	2.5	1.68	1.5	2.4
4		1.5	.7	2.02	3.55	2.02	1.88	1.98	2.7	1.65	1.52	2.65
5				2.0	2.88	1.95	1.75	1.9	2.65	1.65	1.58	2.15
6				2.92	3.2	2.55	1.68	1.88	2.5	1.62	1.5	1.75
7	3.1			2.68	3.45	2.2	1.62	1.82	2.25	1.6	1.52	1.58
8				2.22	3.02	2.0	1.6	1.85	2.12	1.6	1.55	1.55
9				2.12	2.8	1.98	1.6	2.02	1.98	1.58	1.55	1.55
10				2.28	2.75	1.85	1.55	1.85	1.88	1.55	1.52	1.55
11		1.6	.5	2.45	2.55	1.98	1.55	1.72	1.85	1.55	1.5	1.55
12				2.62	2.52	2.35	1.52	1.68	2.12	2.25	1.5	1.55
13				2.62	2.4	2.6	1.5	1.7	1.98	1.98	1.5	1.55
14	1.85			2.55	2.42	2.75	1.5	1.68	1.92	1.92	1.4	1.5
15				2.42	2.75	2.25	1.5	1.75	1.82	1.78	1.42	1.5
16				2.28	2.7	2.05	1.5	2.75	1.8	1.72	1.48	.....
17				2.12	2.7	1.98	1.78	2.15	1.8	1.7	1.5	.....
18		.9	.6	2.0	2.7	2.0	1.7	1.8	2.4	1.7	1.42	.....
19				1.88	2.72	1.98	1.65	1.68	2.3	1.8	1.4	1.5
20				1.58	2.55	1.88	1.88	1.65	2.08	1.72	1.35	1.5
21	1.5		2.2	2.6	2.42	1.88	1.65	1.65	2.02	1.7	1.35	1.5
22			2.3	2.9	2.35	1.9	1.52	1.65	1.9	1.68	1.35	1.48
23			1.68	2.42	2.18	1.82	1.48	1.65	1.85	1.62	1.4	1.45
24			1.5	2.2	2.08	1.7	1.45	1.65	1.8	1.6	1.5	1.45
25		.8	2.3	2.28	2.0	1.62	1.5	1.6	1.88	1.58	1.65	1.45
26			3.4	2.45	2.0	2.12	1.5	1.6	1.9	1.55	1.65	1.45
27			3.0	2.55	2.5	2.3	1.48	2.55	1.82	1.55	1.6	1.45
28	1.4		2.88	2.68	2.28	2.0	1.42	2.05	1.82	1.55	1.6	1.45
29			2.98	2.65	2.22	1.85	1.4	1.75	1.8	1.55	1.7	1.62
30			3.58	2.8	2.15	1.75	1.65	1.98	1.75	1.55	2.1	2.0
31			3.58	.....	2.02	.....	3.05	2.15	.....	1.55	.....	1.7

NOTE.—River frozen January 1 to March 20 and December 16–18. During frozen season gage heights are to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 7[a]	.....	.....	.....	February 18	.9	1.5	1.9
January 14	.....	.....	1.8	February 25	.8	1.4	1.9
January 21	.....	.....	1.9	March 4	.7	1.2	1.9
January 28	1.4	2.1	1.9	March 11	.5	1.15	1.9
February 4, 11	.....	.....	1.9	March 18	.6	1.5	1.9

[a] Water flowing over the ice.

ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

This station was established August 29, 1903, by N. C. Grover. It is located about 800 feet above the mouth of the river, which empties into the Ammonoosuc at a point midway between Fabyans and Twin Mountain, about 2½ miles from either place. The headwaters lie on the slopes of a spur of the White Mountains, at elevations of 2,500 to 3,000 feet. The length of the river from its headwaters to its mouth is about 7 miles. The elevation at the mouth is approximately 1,500 feet. All slopes within the basin are steep. There is no pondage or artificial storage of water. The underlying rock is granite, which is exposed in the mountain peaks. About ten or twelve years ago this basin was entirely deforested and burned over. At the present time there is a thick stand of deciduous growth, consisting of poplar and bird cherry, averaging 12 to 15 feet in height, which affords a thick covering during the summer months, but practically no cover during the winter and spring. Within the basin we find the usual conditions of this stage of reforestation after a thorough burning.

The bed is rough and rocky, but permanent. The current is swift at high and medium at low stages. The banks are high and subject to overflow only in extreme freshets.

Discharge measurements at high stages are made from a highway bridge near the gage. At medium and low water measurements are made by wading close by.

A standard chain gage, which is read once each day by Charles Cote, is attached to trees on the bank just above the highway bridge; length of chain 13.40 feet when established, but changed to 13.24 feet May 3, 1905, and to 13.12 feet August 25, 1905, on account of settling of one of the trees to which the gage is fastened. The gage is referred to bench marks as follows: (1) Top of large bowlder under the gage; elevation, 3.56 feet. (2) Drift bolt driven into the maple tree to which the gage is attached; elevation, 11.32 feet when established, but found to be 11.30 feet August 25, 1905. Elevations are above datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey reports as follows:

Description: 97, pp 90-91; 124, pp 131-132.
Discharge: 97, p 91; 124, p 132.
Discharge, monthly: 124, p 134.
Gage heights: 97, p 91; 124, p 133.
Rating table: 124, p 133.

Discharge measurements of Zealand River near Twin Mountain, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 3 [a]	T. W. Norcross	44	35	1.99	2.67	70
August 4 [a]	do	17	13	1.13	2.08	14.7
August 25 [b]	do	13	9.8	.95	1.99	9.3

[a] By wading. [b] By wading; meter on a rod.

Daily gage height, in feet, of Zealand River near Twin Mountain, N. H., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.85	2.35	2.3	2.6	2.9	2.3	3.0	2.6
2	.....	3.25	2.4	2.9	2.35	2.7	2.3	3.5	2.5
3	.....	3.1	2.7	2.6	2.3	3.0	2.3	2.3	3.0
4	.....	3.0	2.5	2.4	2.2	3.2	2.3	2.5	3.2
5	.....	3.2	2.4	2.3	2.2	2.85	2.3	2.35	3.0
6	.....	3.4	3.0	2.3	2.2	3.0	2.3	2.3	.....
7	.....	3.4	2.7	2.3	2.2	2.65	2.3	2.35	.....
8	.....	3.3	2.6	2.2	2.3	2.5	2.25	2.35	.....
9	.....	3.3	2.5	2.2	2.3	2.4	2.25	2.3	.....
10	.....	3.1	2.45	2.2	2.25	2.35	2.25	2.3	.....
11	.....	3.0	2.3	2.2	2.2	2.3	2.2	2.3	.....
12	.....	3.0	2.7	2.2	2.2	2.3	2.7	2.2	.....
13	.....	2.9	2.8	2.2	2.4	2.5	2.8	2.2	.....
14	.....	2.9	2.7	2.2	2.25	2.45	2.7	2.2	.....
15	.....	2.7	2.5	2.3	2.3	2.35	2.45	2.2	.....
16	.....	2.7	2.4	2.0	2.6	2.3	2.4	2.2	.....
17	.....	2.6	2.4	2.3	2.55	2.3	2.4	2.15	.....
18	.....	2.75	2.3	2.3	2.35	3.2	2.4	2.15	.....
19	.....	2.7	2.3	2.4	2.2	2.65	2.7	2.1	.....
20	.....	2.65	2.3	2.3	2.2	2.5	2.5	2.1	.....
21	.....	2.7	2.4	2.2	2.2	2.5	2.5	2.1	.....
22	.....	2.5	2.55	2.1	2.2	2.5	4.5	2.2	.....
23	.....	2.5	2.3	2.1	2.15	2.45	4.5	2.2	.....
24	.....	2.45	2.3	2.15	2.15	2.35	4.0	2.3	.....
25	.....	2.4	2.2	2.2	2.0	2.45	4.0	2.4	.....
26	.....	2.4	2.5	2.2	2.0	2.4	4.0	2.4	.....
27	3.15	2.6	2.6	2.2	2.75	2.4	3.5	2.4	.....
28	3.05	2.5	2.4	2.15	2.4	2.35	2.5	2.4	.....
29	2.95	2.45	2.35	2.1	2.4	2.3	2.5	2.4	.....
30	2.85	2.4	2.3	2.1	2.9	2.3	2.5	2.6	.....
31	.....	2.35	.....	2.9	3.2	.....	2.5	.....	.....

NOTE.—River frozen January 1 to April 26 and December 6–31.

Station rating table for Zealand River, near Twin Mountain, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	10	2.70	78	3.40	293	4.10	567
2.10	14	2.80	100	3.50	330	4.20	609
2.20	20	2.90	127	3.60	368	4.30	652
2.30	27	3.00	156	3.70	406	4.40	696
2.40	35	3.10	188	3.80	445	4.50	740
2.50	46	3.20	222	3.90	485		
2.60	60	3.30	257	4.00	526		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1903–1905. It is well defined between gage heights 1.9 feet and 2.6 feet.

Estimated monthly discharge of Zealand River near Twin Mountain, N. H., for 1905.

[Drainage area, 14 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	293	31	120	8.57	9.88
June	156	20	48.2	3.44	3.84
July	127	10	29.7	2.12	2.44
August	222	10	38.3	2.74	3.16
September	222	27	65.1	4.65	5.19
October	740	20	143	10.21	11.77
November	330	14	41.3	2.95	3.29
December 1-5	222	46	128	9.14	1.70

LITTLE RIVER NEAR TWIN MOUNTAIN, N. H.

This station was established January 21, 1904, by F. E. Pressey, and discontinued September 15, 1905. It is located at the rough wooden highway bridge about 2 miles southwest of Twin Mountain, and about 2 miles above the entrance of Little River into the Ammonoosuc. The area of the drainage basin at this point is about 11 square miles. This drainage basin is adjacent to that of Zealand River, previously described, and practically all forest cover has been removed from it. The slopes are steep, and there is no pondage or artificial storage. This station was established in order to obtain comparative data as to the time and duration of freshets. A few discharge measurements have been made during 1904 and 1905, but it is not intended to make any estimates of discharge for this point.

The channel is straight for about 50 feet above and 800 feet below the station. The banks are rocky, low, and clean, and liable to overflow. The bed of the stream is of large bowlders and extremely rough. The current is swift at all stages.

A standard chain gage, which is read twice each day by Edward Lynch, is attached to the floor on the downstream side of the bridge; length of chain, 12.92 feet when established, but changed to 12.32 feet August 25, 1905, owing to settling of the gage. The gage is referred to bench marks as follows: (1) A marked point on the floor of the bridge near the zero of the gage scale; elevation, 11.42 feet when established, but found to be 10.73 feet August 25, 1905. (2) A cross on a bowlder on right bank, about 32 feet from end of gage box; elevation, 9.05 feet. Elevations refer to gage datum.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 134–135.

Discharge measurements of Little River near Twin Mountain, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 3 [a]	T. W. Norcross	28	32.7	2.20	5.80	72.
August 25 [b]	do	24	18.3	.72	4.86	13.2

[a] From bridge. [b] By wading; meter fastened to a rod.

Daily gage height, in feet, of Little River near Twin Mountain, N. H., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	5.75	5.25	5.0	5.0	5.55	17	.....	6.25	5.3	5.1	5.05	.....
2	.....	5.65	5.2	5.45	4.8	5.5	18	.....	6.45	5.3	5.0	4.9	.....
3	.....	5.75	5.45	5.5	4.8	6.1	19	.....	6.35	5.4	4.95	4.85	.....
4	.....	6.35	5.4	5.35	4.75	5.8	20	.....	6.05	5.2	4.9	4.8	.....
5	.....	6.3	5.25	5.15	4.7	5.5	21	.....	6.0	5.2	4.9	4.75	.....
6	.....	6.5	5.85	5.05	4.7	5.4	22	.....	5.85	5.15	4.8	4.7	.....
7	.....	6.85	5.45	5.0	4.7	5.4	23	.....	5.6	5.05	4.8	4.8	.....
8	.....	6.45	5.45	5.0	4.95	.....	24	.....	5.55	5.0	4.8	4.7	.....
9	.....	6.5	5.3	4.9	4.95	.....	25	.....	6.05	5.5	5.0	4.8	4.55
10	.....	6.3	5.25	4.9	4.75	.....	26	.....	6.05	5.6	5.3	4.8	4.4
11	.....	6.3	5.2	4.9	4.7	.....	27	.....	6.0	6.15	5.55	4.8	5.4
12	.....	6.25	5.6	4.9	4.7	.....	28	.....	6.0	5.9	5.4	4.7	4.95
13	.....	6.1	5.55	4.9	4.75	.....	29	.....	6.15	5.75	5.25	4.7	4.9
14	.....	6.05	5.65	5.0	4.7	.....	30	.....	6.25	5.75	5.15	4.9	5.7
15	.....	6.1	5.4	4.95	4.75	.....	31	.....	.....	5.55	.....	5.35	5.85
16	.....	6.15	5.3	4.9	5.5	.....							

NOTE.—River frozen January 1 to April 24.

WHITE RIVER AT SHARON, VT.

This station was established July 30, 1903, by H. K. Barrows. It was discontinued April 7, 1905, and no data are available after the year 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 92; 124, p 136.
Discharge: 97, p 92; 124, p 136.
Discharge, monthly: 124, p 138.
Gage heights: 97, p 92; 124, p 137.
Rating table: 124, p 137.

ASHUELOT RIVER AT WINCHESTER, N. H.

This station was established July 10, 1903, by H. K. Barrows. Owing to probable backwater effect from the dam at Ashuelot, about 2½ miles below, and unsatisfactory results, it was discontinued April 7, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 93; 124, p 138.
Discharge: 97, p 93; 124, p 139.
Gage heights: 97, p 93; 124, p 139.

DEERFIELD RIVER AT DEERFIELD, MASS.

Deerfield River is one of the largest tributaries of Connecticut River, having a total drainage area of 667 square miles. It rises in southern Vermont and joins Connecticut River about 1 mile southeast of Greenfield. It is important as a water-power stream, but is not well supplied with storage reservoirs and is consequently subject to considerable fluctuations of flow.

A gaging station was established March 29, 1904, by N. C. Grover, at the suspension highway bridge, about one-fourth mile from the West Deerfield railway station and about 6 or 7 miles above the mouth of the river. The drainage area at this point is 550 square miles. About 2 miles below the station is an old dam, partially destroyed, which is reached by back water from Connecticut River.

The channel is straight for about 600 feet above and 1,000 feet below the station. The banks are high, rocky, and clean, and not liable to overflow. The bed is clean and permanent, the left half being of gravel and the right half of sand. There is but one channel at all stages. The current is medium, becoming sluggish at low water.

Discharge measurements are made from the downstream side of the bridge, the initial point for soundings being the left end of the top chord of the stiffening truss at the downstream side. Low-water measurements are made by wading at a point about one-half mile downstream.

A standard chain gage, which is read twice each day by Mrs. Carrie I. Wellman, is attached to the downstream side of the bridge; length of chain, 32.21 feet. The gage is referred to bench marks as follows: (1) Point on bottom chord of bridge, near the zero of gage scale; elevation, 31.35 feet. (2) On top of downstream foundation of bridge pier on the right bank; elevation, 28.92 feet. (3) Copper bolt set in ledge on left bank, 20 feet upstream from abutment; elevation, 21.04 feet. All elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 140–141.

Discharge measurements of Deerfield River at Deerfield, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 4	T. W. Norcross	319	2,270	1.63	3.97	3,710
August 16	do	315	2,040	.82	3.29	1,680
August 16	do	318	2,120	1.08	3.56	2,290
August 16	do	318	2,140	1.18	3.69	2,520
August 17	do	318	2,130	1.11	3.68	2,380
August 17	do	318	2,110	.95	3.51	2,000
August 17	do	318	2,100	.88	3.42	1,840
August 31	do	314	2,020	.65	3.12	1,310

Daily gage height, in feet, of Deerfield River at Deerfield, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	5.65	3.1	2.45	2.6	3.05	2.95	2.5	2.45	3.45
2	.....	.....	.....	4.35	3.0	2.5	2.55	2.75	2.8	2.5	2.5	3.25
3	.....	.....	.....	4.05	2.8	2.4	2.5	2.55	5.5	2.5	2.5	6.2
4	.....	.....	.....	3.95	2.8	2.5	2.5	2.5	5.05	2.55	2.6	4.6
5	.....	.....	.....	4.2	2.95	2.5	2.6	2.4	4.5	2.6	2.5	3.65
6	.....	.....	.....	5.4	.....	2.5	2.65	2.35	3.65	2.5	2.85	3.2
7	7.2	.....	.....	4.4	2.9	2.5	2.65	2.5	3.35	2.5	3.15	3.1
8	4.5	.....	.....	3.8	2.85	2.7	2.5	2.4	3.2	2.55	3.0	3.0
9	3.75	.....	.....	3.55	2.8	2.6	2.45	2.4	3.1	2.55	2.9	2.9
10	3.35	.....	.....	3.8	2.75	2.6	2.4	2.4	3.0	2.5	2.7	3.0
11	3.35	.....	.....	5.3	2.75	2.55	2.45	2.4	2.7	2.5	2.6	3.05
12	4.05	.....	.....	5.3	2.5	2.5	2.45	3.05	4.1	3.25	2.55	3.0
13	3.95	.....	.....	4.5	2.7	2.5	2.45	2.9	3.5	3.05	2.55	2.9
14	.....	.....	.....	4.15	2.7	2.5	2.4	2.75	3.2	2.9	2.5	2.85
15	.....	.....	.....	3.95	2.7	2.45	2.35	2.5	3.0	2.85	2.5	2.8
16	.....	.....	.....	3.65	3.05	2.4	2.3	3.5	2.9	2.65	2.65	.....
17	.....	.....	.....	3.4	3.2	2.4	2.3	3.6	3.0	2.5	2.7	.....
18	.....	.....	.....	3.3	3.1	2.4	2.2	2.9	3.9	2.55	2.65	.....
19	.....	.....	.....	3.15	3.0	2.3	2.4	2.65	4.75	2.65	2.5	.....
20	.....	.....	.....	3.1	2.65	2.55	2.4	2.3	3.9	3.05	2.45	.....
21	.....	.....	.....	3.5	2.7	2.9	2.4	2.2	3.7	3.4	2.6	.....
22	.....	.....	.....	4.2	2.7	4.3	2.35	2.45	3.4	2.9	2.5	.....
23	.....	.....	.....	3.95	2.6	3.5	2.3	2.5	3.15	2.85	2.6	.....
24	.....	.....	.....	3.35	2.6	3.0	2.2	2.4	2.95	2.8	2.4	.....
25	.....	.....	.....	3.2	2.5	2.8	2.3	2.4	2.8	2.75	2.45	.....
26	.....	.....	.....	3.25	2.5	2.75	2.35	2.45	2.8	2.7	2.5	.....
27	.....	.....	6.6	3.4	2.45	3.1	2.35	2.45	2.75	2.6	2.45	.....
28	.....	.....	5.45	3.3	2.5	2.85	2.35	2.4	2.7	2.55	2.4	.....
29	.....	.....	5.5	3.3	2.5	2.7	2.4	2.35	2.65	2.5	3.05	.....
30	.....	.....	5.9	3.2	2.5	2.7	3.4	2.5	2.6	2.45	4.7	.....
31	.....	.....	6.35	.....	2.5	.....	3.5	3.15	.....	2.45	.....	.....

NOTE.—River clear of ice January 7-13, frozen January 1-6 and January 14 to March 26. Ice went out of river on night of March 26. River frozen December 16-31.

WARE RIVER NEAR WARE, MASS.

Ware River is formed in the town of Barre by the junction of several small streams. The surrounding country is hilly and largely cleared. The total drainage area is about 162 square miles and is tributary to Chicopee River, which drains a large section of central Massachusetts and is the largest tributary of the Connecticut in respect of drainage area, its basin containing 730 square miles. Chicopee River is formed at Three Rivers by the union in that vicinity of Ware, Swift, and Quaboag rivers; thence runs westward about 15 miles, joining the Connecticut at Chicopee. Chicopee River and its tributaries are quite important water-power streams, and expensive developments have been made on them.

A gaging station was established September 15, 1904, by H. K. Barrows, at the steel highway bridge about 2 miles above the village of Ware, Mass. The bridge has a span of about 85 feet.

The channel is curved for some distance above and straight below the bridge. The bed of the stream is rocky, with some gravel. The banks are medium in height and overflow at very high water, when there will be two or more channels. The current is swift at high stages and well sustained at low stages.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the left abutment at the top.

A standard chain gage is fastened to the floor timbers of the bridge on the upstream side, toward the right bank; length of chain, 14.10 feet. The gage is read wice each day by M. N. Richards, the expense of such readings being borne equally by the Otis Company and the George H. Gilbert Manufacturing Company, both of Ware. The gage is referred to bench marks as follows: (1) On post of bridge railing at east end of gage; elevation, 17.01 feet. (2) On west abutment on downstream side about 18 inches from the corner near the truss; elevation, 11.48 feet. (3) Southeast corner of abutment of railroad culvert, about 250 feet north of the Boston and Maine Railroad crossing, west of gage; elevation, 18.63 feet. All elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 142–143.

Discharge measurements of Ware River near Ware, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 28	T. W. Norcross	83	459	5.56	6.92	2,550
March 28	do	83	465	5.59	6.96	2,600
April 1	do	83	370	4.59	5.75	1,690
April 7	do	83	303	4.09	5.06	1,240
April 13	do	83	212	3.58	4.00	758
April 29	do	79	108	1.98	2.74	214
May 17	do	80	120	2.27	2.89	272
July 29	do	68	87	1.56	2.46	136
August 11	do	66	78	1.56	2.37	122
August 11	do	58	52	.83	1.94	43
September 7	do	83	315	3.48	5.20	1,100
September 26	do	80	108	2.08	2.77	225

Daily gage height, in feet, of Ware River near Ware, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				5.9	2.9	2.4	2.3	2.5	2.5	2.05	2.7	3.1
2				5.1	2.8	2.4	2.7	2.75	2.3	2.75	2.6	2.75
3				4.7	2.85	2.0	1.95	2.55	3.3	2.9	2.6	3.4
4			3.8	4.3	2.9	1.65	2.1	2.8	6.3	2.8	2.4	4.7
5		4.3		4.0	2.8	2.1	2.0	2.7	6.65	2.9	2.4	3.9
6				4.8	2.4	2.55	2.4	2.65	6.1	2.65	2.8	4.0
7				5.0	2.25	3.15	1.7	2.45	4.6	2.3	2.85	3.5
8				4.6	2.6	2.5	1.75	2.6	3.8	2.1	2.65	3.4
9			3.7	4.0	2.45	2.75	2.25	2.75	4.0	2.55	2.6	3.0
10				4.0	2.5	2.5	2.4	2.5	3.25	2.8	2.7	2.8
11	6.3			4.05	2.4	2.1	2.6	2.2	3.2	2.5	2.2	2.9
12				4.45	2.6	2.6	2.3	2.5	3.3	2.85	2.25	3.15
13				4.15	2.3	2.9	2.05	2.8	3.55	2.8	2.7	3.1
14		3.3	4.1	3.9	2.3	2.5	2.55	2.7	3.1	2.8	2.5	2.9
15			3.55	3.8	2.6	2.7	2.5	2.65	3.1	2.95	2.8	3.2
16	5.4		3.35	3.65	2.95	2.6	2.7	3.3	3.15	2.8	2.65	3.35
17			3.0	3.4	2.7	2.2	2.2	3.5	2.7	2.75	2.65	2.6
18			3.05	3.35	3.0	2.2	2.5	3.4	3.1	2.7	2.3	4.05
19			5.25	3.25	2.7	2.15	2.4	3.15	2.8	2.8	2.15	3.3
20			5.35	3.45	2.6	2.5	2.5	2.4	3.0	2.85	2.65	2.8
21			4.5	3.35	2.3	2.8	2.65	2.5	3.05	3.1	2.6	2.8
22	4.85		3.95	3.35	2.45	3.2	1.9	2.6	3.15	2.6	2.75	3.15
23			3.8	3.1	2.6	3.45	2.3	2.7	2.85	2.9	2.65	3.4
24		4.2	3.75	3.6	2.5	3.1	2.4	2.6	2.55	2.75	2.8	3.1
25			5.65	3.3	2.8	3.0	2.5	2.7	3.0	2.8	2.35	3.05
26			7.1	3.3	2.7	2.7	2.5		2.85	2.7	2.8	3.1
27			7.3	3.1	2.6	2.5	2.5	2.5	2.8	2.7	2.6	3.05
28			7.05	3.05	2.4	2.5	2.6	2.9	2.8	2.4	2.7	3.1
29			6.6	3.0	2.35	2.5	1.7	2.6	2.8	2.35	2.8	3.0
30	4.4		6.4	2.8	2.25	2.5	2.3	2.95	2.55	2.6	3.25	3.3
31			6.1		2.3		2.3	2.5		2.8		2.8

NOTE.—River frozen January 1 to March 15, when ice went out. During this period the readings were taken to the top of the ice. The thickness of the ice was measured, as follows:

	Feet.		Feet.
January 11	1.2	February 24	1.9
January 16, 22	1.7	March 4	2.5
January 30	1.8	March 9	1.6
February 5, 14	2.1		

Station rating table for Ware River near Ware, Mass., from September 15, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	42	3.00	294	4.10	718	5.20	1,332
2.00	55	3.10	325	4.20	768	5.40	1,460
2.10	71	3.20	357	4.30	820	5.60	1,590
2.20	89	3.30	390	4.40	873	5.80	1,725
2.30	109	3.40	424	4.50	927	6.00	1,865
2.40	131	3.50	460	4.60	982	6.20	2,005
2.50	155	3.60	498	4.70	1,038	6.40	2,155
2.60	180	3.70	538	4.80	1,095	6.60	2,305
2.70	207	3.80	580	4.90	1,153	6.80	2,460
2.80	235	3.90	624	5.00	1,212	7.00	2,620
2.90	264	4.00	670				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1904–5. It is well defined between gage heights 1.9 feet and 7 feet.

Estimated monthly discharge of Ware River near Ware, Mass., for 1904–5.

[Drainage area, 162 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 15–30	846	109	293	1.81	1.08
October	294	80	192	1.19	1.37
November	357	55	182	1.12	1.25
December 1–9	221	71	172	1.06	.355
1905.					
March 15–31	2,560	294	1,367	8.44	5.34
April	1,795	235	650	4.01	4.47
May	294	99	177	1.09	1.26
June	442	16	180	1.11	1.24
July	207	20	121	.747	.861
August	460	89	214	1.32	1.52
September	2,342	109	513	3.17	3.54
October	325	63	207	1.28	1.48
November	374	80	188	1.16	1.29
December	1,038	180	377	2.33	2.69

NOTE.—River frozen December 10–31, 1904; January 1 to March 15, 1905. Discharge interpolated August 26, 1905.

WARE RIVER AT GILBERTVILLE, MASS.

Records of flow of Ware River have been kept at the lower mill through the courtesy and assistance of the George H. Gilbert Manufacturing Company, at Gilbertville, since September 22, 1904. The drainage area at this point is 160 square miles. The lower dam is 101.5 feet long, with a fairly even crest. The greater part of the time, however, all of the water at this point is used through the wheels, and the record is kept largely by means of the record of wheel openings. These wheels have been rated at Holyoke, and, in addition to this, current-meter gagings are made from time to time as a check on the flow. The average head on wheels is about 19.5 feet. Records of flow at this point during 1904–5 are withheld, awaiting confirmation of data.

QUABOAG RIVER AT WEST WARREN, MASS.

Quaboag River is about 25 miles in length, and has a drainage area of 213 square miles. It is an especially valuable stream as regards water power, on account of its well-sustained flow and absence of effect from freshets. There is still a large amount of power below West Warren which is not developed.

A station for securing a record of flow of Quaboag River has been maintained by the United States Geological Survey at West Warren at the dam of J. T. F. MacDonnell, of Holyoke, since October 22, 1904. The drainage area at this point is 144 square miles. The dam is a timber crib, 102.7 feet long, between vertical abutments, and affords a fall of about 13 feet. This dam is leased by the Composite Leather Company, but no power is used at the present time, so that the whole flow is over the dam.

A plain staff gage is placed near the canal head-gates at the dam, on the left side. Elevation 50 of this gage corresponds to the level of the crest of the dam. This gage is read once a day by Amory Crossman.

Mean daily discharge, in second-feet, of Quaboag River at West Warren, Mass., from July to October, 1903.[a]

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	[b] 218	127	116	[b] 52	17	.....	.....	233	151
2	233	129	124	81	18	.....	.....	208	202
3	207	130	[b] 131	78	19	.....	.....	178	.....
4	192	115	[b] 73	105	20	[b] 158	.....	164	.....
5	[b] 174	239	112	90	21	219	[b] 109	151	.....
6	.....	241	121	82	22	225	111	125	.....
7	.....	224	118	95	23	228	106	133	.....
8	.....	196	116	99	24	209	101	123	.....
9	.....	191	114	144	25	182	120	115	.....
10	[b] 93	[b] 214	117	145	26	172	113	110	.....
11	128	.....	123	140	27	160	116	129	.....
12	170	.....	116	158	28	150	119	[b] 158	.....
13	270	.....	106	148	29	145	136	.....	.....
14	217	.....	112	118	30	136	146	.....	.....
15	211	.....	127	108	31	150	136	.....	.....
16	[b] 197	.....	151	102					

[a] From automatic gage records kept by Massachusetts State Board of Health.
[b] Average of less than 24 hourly readings.

Estimated monthly discharge of Quaboag River at West Warren, Mass., for 1904 and 1905.

[Drainage area, 144 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
October 25-31	182	106	153	1.06	0.276
November	182	30	82	.569	.635
December	229	10	76	.528	.609
1905.					
January	605	123	267	1.85	2.13
February	161	89	120	.833	.867
March	1,206	106	525	3.65	4.21
April	931	226	556	3.86	4.31
May	229	106	148	1.03	1.19
June	106	55	88	.611	.682
July	106	20	59	.410	.473
August	72	30	50	.347	.400
September	476	72	104	1.42	1.58
October	106	72	90	.625	.721
November	89	55	83	.576	.643
December	306	89	187	1.30	1.50
The year	1,206	20	198	1.38	18.71

NOTE.—Estimates are based on one gage reading per day, taken at about 6.15 a. m. (before mill upstream starts up) on week days, and on Sundays at about 4 p. m.

SWIFT RIVER AT WEST WARE, MASS.

Swift River is about 30 miles long and has a total drainage area of 218 square miles. It drains a hilly country very similar to that of Ware River, but perhaps more thickly wooded. There is enough storage on this river to make the flow well sustained during the dry period.

Records of flow of Swift River have been kept at the mill of the West Ware Paper Company, through the courtesy of Dwight Holland, manager, since October 21, 1904. The drainage area at this point is 188 square miles. The dam at West Ware is a timber crib, and has a total length of 150 feet between vertical abutments, with a fairly good crest. A considerable portion of the time all of the water is used at this point through the wheels, and the record is kept largely by means of them. One of the wheels has been rated at Holyoke, and additional current-meter measurements are made to serve as a check on the computations. The average head on the wheels is about 11 feet.

April 14, 1905, this mill was totally destroyed by fire, so that records here have been interrupted.

WESTFIELD RIVER AT RUSSELL, MASS.

The main branch of Westfield River rises in the northeastern part of Berkshire County, entering Connecticut River at Springfield, with a total length of about 55 miles. Its principal tributaries are West Branch and Middle Branch, respectively; the length of West Branch from the mouth is 22 miles and that of Middle Branch 24 miles. The country in this drainage basin is very hilly and even mountainous at its headwaters. Slopes are steep and rocky. There is little storage, and consequently rapid fluctuations in the flow.

A gaging station was established April 1, 1904, by N. C. Grover. It is located at the steel highway bridge near the railway station at Russell, Mass. This bridge has two spans, which are about 250 feet long. The drainage area at this point is 331 square miles.

The channel is straight for 1,000 feet above and below the station. The bed of the stream is of gravel and small bowlders, very rough but permanent. Both banks are high, rocky, and clean, and not subject to overflow. There are two channels at all stages; the current is swift at all times.

Discharge measurements are made from the bridge. The initial point for soundings is the face of the left abutment, on the downstream side, at the top.

A standard chain gage, which is read twice each day by B. A. Silliman, is attached to the upstream side of the bridge near the center of the left span; length of chain, 23.98 feet. The gage is referred to bench marks as follows: (1) Top of plank floor near the zero of gage scale; elevation, 22.89 feet. (2) Upstream inner corner of left abutment near post; elevation, 22.31 feet. (3) Upstream inner corner of right abutment near post; elevation, 24.76 feet. All elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pages 145–146.

Discharge measurements of Westfield River at Russell, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 5	T. W. Norcross	214	524	5.11	2.81	2,680
April 15	do	196	376	4.23	2.12	1,590
April 25	do	186	233	3.15	1.32	735
May 19	do	187	230	2.09	1.20	480
July 15[a]	Barrows and Norcross	129	151	1.10	.75	167

[a] By wading one-half mile above gage.

Daily gage height, in feet, of Westfield River, at Russell, Mass., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.9	1.3	0.8	0.8	1.3	1.2	0.85	0.95	1.5
2	.....	2.9	1.25	.8	.75	1.0	1.0	.9	1.0	1.3
3	.....	2.3	1.2	.85	.7	.9	4.4	.9	.95	.....
4	.....	2.25	1.15	.8	.7	.8	6.5	1.0	1.05	.....
5	.....	2.85	1.1	.8	.6	.8	3.05	.95	1.1	.....
6	.....	4.3	1.1	.85	.7	.6	2.0	.9	1.1	.....
7	.....	2.7	1.1	1.1	.7	.7	1.55	.8	1.65	1.5
8	.....	2.3	1.1	1.05	.7	.85	1.4	.85	1.4	1.55
9	.....	2.2	1.05	.9	.6	.8	1.2	.8	1.25	1.4
10	.....	2.3	1.1	.85	.6	.7	1.1	.8	1.1	1.4
11	.....	2.9	1.0	.8	.7	.7	1.1	.8	1.1	1.6
12	.....	3.05	1.1	.8	.95	1.1	2.3	1.9	1.05	1.9
13	.....	2.3	1.1	.9	.8	1.05	2.35	1.5	1.0	1.3
14	.....	2.15	1.15	.9	.8	.9	1.55	1.2	1.0	1.1
15	.....	2.1	1.25	.9	.6	.9	1.35	1.1	.9	1.05
16	.....	1.9	1.45	.9	.6	1.4	1.3	1.1	1.0	1.25
17	.....	1.8	1.4	.8	.6	1.5	1.3	1.0	1.05	.....
18	.....	1.65	1.3	.75	.6	1.1	1.4	.95	1.0	.....
19	4.0	1.6	1.2	.7	.6	.9	1.75	1.1	1.0	.....
20	3.25	1.55	1.1	.95	.7	.8	1.4	1.8	1.4	.....
21	2.25	1.8	1.0	.95	.6	.8	1.6	1.7	1.4	.....
22	2.1	1.75	1.0	1.85	.6	.85	1.4	1.3	1.4	.....
23	2.0	1.5	1.0	1.65	.6	.8	1.2	1.2	1.0	.....
24	1.8	1.4	.95	1.15	.5	.85	1.1	1.1	1.0	.....
25	3.1	1.35	.9	.95	.55	.8	1.1	1.0	1.0	.....
26	3.5	1.3	.9	.9	.7	1.0	1.0	1.0	1.0	.....
27	4.4	1.3	.9	1.0	.65	.85	.9	1.0	1.0	.....
28	3.95	1.35	.85	.9	.6	.85	.95	1.0	1.0	.....
29	4.1	1.3	.8	.8	.6	.9	.9	.95	1.3	.....
30	4.45	1.3	.85	.8	2.2	.9	.85	1.0	2.95	.....
31	4.5	.....	.8	.....	1.85	1.3	.....	.95	.....	.....

NOTE.—River frozen January 1 to March 18 and December 17-31. River clear of ice March 20.

WESTFIELD LITTLE RIVER NEAR BLANDFORD, MASS.

Westfield Little River is formed by the union of Peebles and Borden brooks in the southern part of the town of Blandford. The headwaters of Peebles Brook are in North Blandford, at an elevation of about 1,400 feet, while at its junction with Borden Brook it has an elevation of about 850 feet, a fall of 550 feet in a distance of about 8 miles. Below Borden Brook the fall is also very rapid, reaching an elevation of 200 feet in the vicinity of West Parish, a distance of 6 miles from Borden Brook. The drainage area at the junction of Peebles and Borden brooks is about 43 square miles; at the mouth of the river, 83.6 miles. The slopes are very steep, and in places precipitous. The greater part of the basin above West Parish is in forest. It is expected that Westfield Little River will be used as the municipal water supply for the city of Springfield, for which a dam and reservoir are being planned in the vicinity of Cobble Mountain.

A gaging station was established July 13, 1905, by H. K. Barrows, at Cobble Mountain, near Blandford, Mass. It is located a short distance below Borden Brook, and is maintained in cooperation with the water board of the city of Springfield, through their engineer, E. E. Lochridge.

The channel is straight for 100 feet above and 200 feet below the station. The bed is very rough and rocky, though it has been improved somewhat by the aid of dynamite. The left bank is high and steep, but the right bank is liable to overflow in

extreme high water. The channel is fairly permanent, but in extreme freshets is liable to change, this having occurred during the present season, as noted in connection with the list of discharge measurements. The current is swift at high and medium at low stages. The flow is free and very little affected by artificial conditions.

Discharge measurements at medium and high stages are made from a car suspended from a cable of 140-foot span. The initial point for soundings is a 6-inch maple tree on the left bank in the line of the cable. All low-water measurements are made by wading at various sections.

A staff gage is bolted to a large rock on the left bank of the river. A standard chain gage is also attached to a tree on the left bank a short distance above the staff gage. The length of the chain is 11.43 feet. Gage readings are made twice each day by S. H. Bodurtha. Both gages have the same datum, and are referred to bench marks as follows: (1) Circular chisel draft in highest point of stone to which the staff gage is attached; elevation, 5.00 feet. (2) Chiseled T near the gage on the same stone, for measurement to water surface; elevation, 3.51 feet. (3) Center of head of nail in largest tree on right bank opposite the gage; elevation, 8.55 feet. All elevations refer to datum of the gage.

Discharge measurements of Westfield Little River near Blandford, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec-feet.*
July 14 [a]	Barrows and Norcross	34	44	0.73	2.32	32.4
August 10 [a]	Norcross and Lockridge	32	51	.47	2.30	23.8
September 8 [a]	do	46	73	1.12	2.98	82.
September 27 [a]	T. W. Norcross	39	54	.49	2.40	26.5
September 28 [a]	do	39	53	.48	2.39	25.7
October 13 [b]	do	44	77	1.10	2.94	85.
October 14 [b]	do	42	71	.83	2.76	59.
November 9 [b]	Norcross and Lockridge	39	59	.68	2.57	40.1

[a] By wading; meter on a rod. [b] From cable car.

NOTE.—The measurement of July 14 is not comparable with the measurements which follow, on account of changed conditions of bed of river, caused by freshet of July 30.

Daily gage height, in feet, of Westfield Little River near Blandford, Mass., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.5	2.47	2.32	2.38	3.28	17	1.98	2.8	2.8	2.5	2.47	[a] 2.9
2	.....	3.05	2.5	2.32	2.38	[a] 3.3	18	1.92	2.53	3.0	2.48	2.45	[a] 3.0
3	.....	2.84	4.08	2.58	2.35	4.18	19	2.25	2.34	3.01	2.46	2.4	[a] 3.0
4	.....	2.68	5.25	2.46	2.75	3.88	20	2.26	2.26	2.9	3.2	[a] 2.5	[a] 3.0
5	.....	2.46	4.35	2.39	2.58	[a] 3.4	21	2.13	2.19	2.98	2.95	[a] 2.6	[b] 4.0
6	.....	2.32	3.6	2.34	2.68	3.3	22	2.0	2.16	2.84	2.73	[a] 2.6	3.45
7	.....	2.46	3.25	2.3	2.78	3.15	23	1.94	2.1	2.68	2.59	[a] 2.6	3.3
8	.....	2.41	3.0	2.28	2.68	3.0	24	1.9	2.08	2.58	2.6	2.5	3.18
9	.....	2.4	2.84	2.28	2.59	2.95	25	1.93	2.8	2.52	2.6	2.5	3.0
10	.....	2.3	2.68	2.25	2.55	3.0	26	1.88	2.58	2.44	2.53	2.48	3.0
11	.....	2.38	2.6	2.24	2.48	[a] 3.1	27	1.86	2.42	2.44	2.46	2.48	2.9
12	.....	2.36	3.66	3.45	2.46	[a] 3.1	28	1.84	2.37	2.42	2.43	3.32	2.9
13	2.58	2.24	3.65	2.98	2.44	[a] 3.1	29	1.9	2.49	2.36	2.4	3.52	3.85
14	2.37	2.14	3.3	2.76	2.44	[a] 3.0	30	7.75	2.68	2.36	2.4	3.38	3.48
15	2.25	2.44	2.95	2.6	[a] 2.52	[a] 2.9	31	4.3	2.57	.....	2.37	.....	3.05
16	2.06	2.95	2.82	2.51	[a] 2.49	2.9							

[a] Anchor ice in river. [b] River clear of ice.

NOTE.—Gage heights during freshet of July 30 estimated. Crest of flood was at gage height, 8 feet at 8.30 a. m., as determined afterwards with a level, using marks on trees. Relation of gage heights to discharge changed by this flood.

SALMON RIVER AT LEESVILLE, CONN.

This station was established March 28, 1905, by H. K. Barrows. It is located at the plant of the East Haddam Electric Light Company at Leesville, a short distance above the bridge on the highway leading from Leesville to Easthampton. The drainage area at this point is 115 square miles. The station is maintained through the cooperation of Messrs. Ransom & Hoadley, of Providence, R. I., who are expecting to build at this point a dam about 72 feet in height for developing light and power, which will probably be used in Hartford.

The channel is curved more or less above and below the station. The bed is rather rough and rocky; banks in the vicinity of the gage are high and steep, but a short distance below the bridge they become of medium height. The current is good at the places used for measurement by wading, but is apt to be small and poorly distributed in the vicinity of the bridge during ordinary stages. This station may be influenced for a time during the spring by backwater effect from Connecticut River, into which it flows about 5 miles below this point. The effect of the tide is experienced nearly up to the highway bridge, but it is believed that gage readings are not affected by it. During the low-water season no water is allowed to flow by the dam during the daytime, consequently it has been necessary to get a number of gage readings, most of which were in the night, to determine the mean flow for the day.

Discharge measurements at ordinary and low stages are made by wading at various sections in the vicinity. At high water they are made from the bridge, where there is a clear span of about 100 feet.

A vertical staff gage is fastened to the side wall of the tailrace near its entrance into the river. An additional staff gage is fastened to the foundation wall of the electric-light station for high-water observations. Gage readings are taken by E. W. Crocker, superintendent of the electric-light plant. The two gages are referred to bench marks, as follows: (1) Circular chisel draft on stone near staff gage in tailrace; elevation, 2.98 feet. (2) Circular chisel draft on bowlder, 36 feet south and 8 feet west of southeast corner of electric-light station; elevation, 4.51 feet. (3) Chiseled cross on ledge 20 feet east and 5 feet north of southeast corner of old power-house foundation; elevation, 9.27 feet. All elevations are above datum of the gage.

Discharge measurements of Salmon River at Leesville, Conn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28 [a]	Barrows and Norcross	120	112	1.48	1.34	166
May 16 [a]	T. W. Norcross	122	121	1.46	1.38	177
May 26 [a]	do	98	82	.89	.70	73
December 5 [b]	do	102	400	.82	1.97	330

[a] By wading; meter on a rod.
[b] From downstream side of highway bridge; about one-eighth of discharge is estimated.

HOUSATONIC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Housatonic River has its source in Berkshire County, Mass. It flows southward across Massachusetts and the west end of Connecticut, entering Long Island Sound. Its course is nearly parallel to the eastern boundary of New York State, and it receives the drainage from Tenmile River in New York.

Tenmile River drains an area of diversified topography, including broad flats and marshes in the basin of Swamp River and extensive areas under cultivation and sparsely timbered hills in the region of the Chestnut Range. The drainage area lies chiefly in New York State, the stream crossing the line into Connecticut one-half mile above the junction with the Housatonic.

HOUSATONIC RIVER AT GAYLORDSVILLE, CONN.

This station was established October 24, 1900, by E. G. Paul. It is located at the covered wooden highway bridge at Gaylordsville, 2 miles below the mouth of Tenmile River.

The channel is straight for about 500 feet above and below the measuring section, and there is sufficient velocity at all stages to permit of accurate measurement. At high water the current is swift and rough. Both banks are subject to overflow only during extreme freshets; both have a sparse growth of trees and brush. The bed of the stream is composed of gravel and cobblestones, free from vegetation, and not subject to change.

On account of the poor cross section of the bridge discharge measurements are made by means of a cable and car 1¼ miles below. The cable has a span of 200 feet. The initial point for soundings is the zero of the tagged wire at the sycamore tree which supports the cable on the left bank.

A standard chain gage, which is read twice each day by G. H. Monroe, is fastened to the woodwork of the inside of the bridge; length of chain, 30.45 feet. No bench marks have been established. The center of the gage pulley is 29.35 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 47, pp 35–36; 65, pp 87–88; 82, p 121; 97, p 94; 124, p 147.
Discharge: 47, p 36; 65, p 88; 82, p 122; 97, p 95; 124, p 148.
Discharge, daily: 97, pp 98–101; 124, p 151.
Discharge, low-water: 65, pp 89–90.
Discharge, monthly: 75, p 24; 97, pp 102–103; 124, p 152.
Gage heights: 47, p 36; 65, p 89; 82, p 122; 97, p 96; 124, p 149.
Hydrographs: 75, p 24.
Rating tables: 65, p 318; 97, p 97; 124, p 150.

Daily gage height, in feet, of Housatonic River at Gaylordsville, Conn., for 1905:

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	4.4	4.2	8.4	4.8	4.0	3.4	4.65	4.0	4.05	4.05	5.05
2	4.3	4.45	4.3	7.95	4.8	3.65	3.4	4.4	3.8	4.0	4.0	5.0
3	4.45	4.5	4.25	7.7	4.8	3.9	3.55	4.2	4.8	4.1	3.95	5.55
4	4.5	4.4	4.2	7.0	4.75	3.9	3.4	3.95	6.35	4.3	4.0	6.5
5	4.4	4.45	4.1	6.8	4.65	3.7	3.35	3.8	6.85	4.15	4.0	6.3
6	4.4	4.4	4.1	7.3	4.5	3.75	3.2	3.45	6.35	4.15	4.2	5.65
7	8.4	4.4	4.15	7.15	4.4	4.35	3.3	3.5	5.7	4.2	4.2	5.45
8	8.0	4.5	4.15	6.8	4.45	4.2	3.4	3.5	5.45	4.1	4.4	5.1
9	6.65	4.3	4.3	6.75	4.8	4.1	3.25	3.45	5.05	4.0	4.3	5.15
10	6.5	4.3	4.7	6.6	4.3	4.2	3.25	3.65	4.7	3.95	4.35	5.2
11	6.25	4.4	5.65	6.55	4.45	4.05	3.25	3.7	4.6	3.9	4.3	5.2
12	6.1	4.4	5.3	6.65	4.4	4.0	3.35	3.8	5.0	4.4	4.2	4.8
13	6.4	4.25	5.1	6.55	4.55	4.05	3.35	3.75	5.1	4.7	4.1	4.95
14	5.65	4.2	5.0	6.2	4.15	4.2	3.3	3.5	5.2	4.5	4.05	4.75
15	5.45	4.35	4.95	5.75	4.45	4.05	3.45	3.6	5.1	4.4	4.0	4.6
16	5.4	4.4	4.7	5.8	4.45	3.95	3.7	3.9	5.15	4.3	3.6	4.6
17	5.2	4.3	4.8	5.8	4.5	4.0	3.6	4.1	4.7	4.1	4.0	4.2
18	5.1	4.2	4.75	5.45	4.55	3.55	3.45	3.9	4.55	4.15	4.0	4.35
19	5.05	4.2	6.6	5.45	4.55	3.4	3.25	3.9	4.8	4.15	3.95	4.1
20	5.1	4.1	7.3	5.35	4.5	3.45	3.25	3.8	4.95	4.3	3.8	4.5
21	5.1	4.1	6.65	5.5	4.3	3.8	3.3	3.75	4.95	4.5	3.8	4.85
22	5.1	4.15	6.6	5.55	3.85	3.95	3.25	3.5	5.0	4.65	3.75	5.5
23	5.0	4.0	6.55	5.3	4.25	4.15	3.15	3.35	4.8	4.4	3.7	5.5
24	4.65	4.0	6.65	5.1	4.25	4.3	3.4	3.55	4.55	4.1	3.9	5.15
25	4.6	4.1	8.15	5.1	4.0	3.5	3.4	4.1	4.4	4.3	4.0	4.95
26	4.6	4.2	8.1	5.05	4.05	4.0	3.25	4.0	4.3	4.3	3.7	4.7
27	4.6	4.2	9.1	5.0	4.0	4.0	3.5	3.7	4.2	4.25	3.75	4.7
28	4.5	4.2	9.05	5.0	4.1	3.7	3.35	3.8	4.25	4.2	3.85	4.7
29	4.7	.....	8.8	5.0	3.85	3.5	3.15	3.6	4.15	4.25	4.3	4.9
30	4.6	.....	8.8	4.8	3.8	3.6	3.35	3.65	4.0	4.35	5.0	4.8
31	4.5	.....	8.65	.....	4.0	.....	4.05	4.3	.....	4.4	.....	4.85

NOTE.—January 1, ice 1 foot thick along edges. January 7, ice went out. January 7-25, river open. January 26, observer notes river open at gage, but frozen across 5 inches thick about 35 rods below the gage. Ice along banks above gage; no anchor ice. This condition held nearly constant with slight increase of ice along banks until March 11, when ice began to melt. River clear March 18.

Station rating table for Housatonic River at Gaylordsville, Conn., from October 23, 1900, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	120	4.60	1,506	6.60	5,204	8.60	10,430
2.60	157	4.70	1,642	6.70	5,448	8.70	10,700
2.70	198	4.80	1,778	6.80	5,692	8.80	10,980
2.80	230	4.90	1,914	6.90	5,936	8.90	11,250
2.90	266	5.00	2,050	7.00	6,180	9.00	11,530
3.00	303	5.10	2,216	7.10	6,440	9.10	11,800
3.10	352	5.20	2,382	7.20	6,700	9.20	12,080
3.20	402	5.30	2,548	7.30	6,960	9.30	12,350
3.30	451	5.40	2,714	7.40	7,220	9.40	12,630
3.40	501	5.50	2,880	7.50	7,480	9.50	12,900
3.50	550	5.60	3,076	7.60	7,744	9.60	13,180
3.60	618	5.70	3,272	7.70	8,008	9.70	13,460
3.70	686	5.80	3,468	7.80	8,272	9.80	13,740
3.80	754	5.90	3,664	7.90	8,536	9.90	14,020
3.90	822	6.00	3,860	8.00	8,800	10.00	14,300
4.00	890	6.10	4,080	8.10	9,070	10.10	14,600
4.10	986	6.20	4,300	8.20	9,340	10.20	14,900
4.20	1,082	6.30	4,520	8.30	9,610	10.30	15,200
4.30	1,178	6.40	4,740	8.40	9,880	10.40	15,500
4.40	1,274	6.50	4,960	8.50	10,150	10.50	15,800
4.50	1,370						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900–1904. It is well defined between gage heights 3 feet and 5 feet. Above 5 feet the measurements are scattered.

Estimated monthly discharge of Housatonic River at Gaylordsville, Conn., for 1905.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 7–25	9,880	1,506	3,652	3.58	2.53
March 18–31	11,800	1,710	7,791	7.64	3.98
April	9,880	1,778	4,321	4.24	4.73
May	1,778	754	1,246	1.22	1.41
June	1,226	501	837	.821	.916
July	938	377	494	.484	.558
August	1,571	476	773	.758	.874
September	5,814	754	2,056	2.02	2.25
October	1,642	822	1,131	1.11	1.28
November	2,050	618	956	.937	1.05
December	4,960	1,082	2,183	2.14	2.47

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 165.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

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2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
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WASHINGTON, D. C.

MAY, 1906.

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Water-Supply and Irrigation Paper No. 166 Series P, Hydrographic Progress Reports, 42

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART II.—Hudson, Passaic, Raritan, and Delaware River Drainages

BY

R. E. HORTON, N. C. GROVER, and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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The chief features of the hydrographic work are the collection of data relating to the flow of surface waters and the study of the conditions affecting this flow. There is also collected information concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely upon the physical features and the needs of each locality.

If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

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Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

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Chowan.	Santee.
Roanoke.	Savannah.
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Cape Fear.	Minor southern Atlantic.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given as far as available the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the two remaining columns, which are defined above, are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal .44 acre-feet.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5169842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1.196 square yards.

1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepower equals about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec. ft.} \times \text{fall in feet}}{11}$ = Net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\, h^{\frac{3}{2}}$; l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1 : 125,000, 1 mile=0.50688 inch.
Scale 1 : 90,000, 1 mile=0.70400 inch.
Scale 1 : 62,500, 1 mile=1.01376 inches.
Scale 1 : 45,000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief description is given.

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data upon which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of the water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{3/2}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flashboards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are

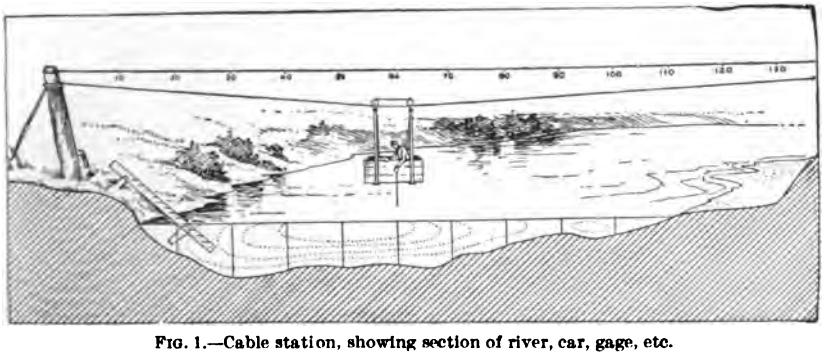

FIG. 1.—Cable station, showing section of river, car, gage, etc.

good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula, and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as "equipment." These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or debris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types; those in which the wheel is made up of a series of cups, as the Price, and those having a screw propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, a boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending upon the size and conditions of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point in the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected.

They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pages 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads, and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current and the quantity of water flowing, and a thorough knowledge of the conditions at and in the vicinity of the station.

The construction of the rating table depends upon the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve, under normal conditions, is concave toward the horizontal axis and is generally parabolic in form.

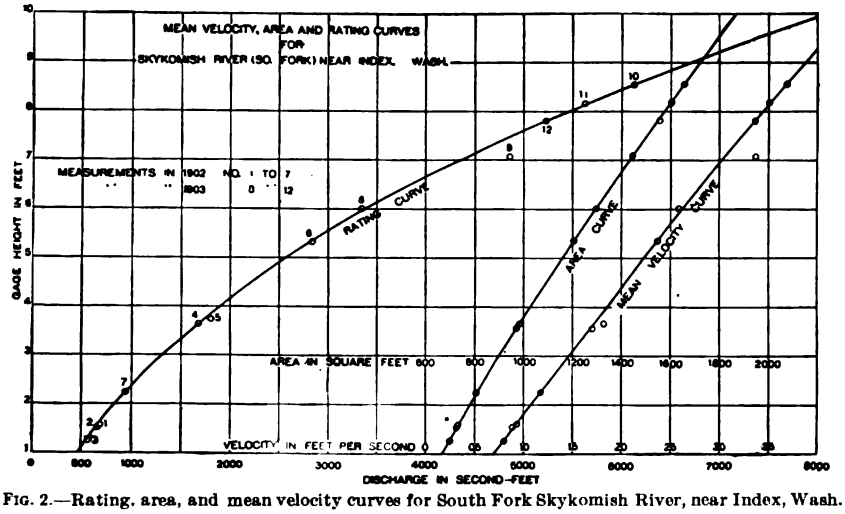

FIG. 2.—Rating, area, and mean velocity curves for South Fork Skykomish River, near Index, Wash.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height, or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have aided in furnishing and preparing the data contained in this report:

New Jersey.—District hydrographer N. C. Grover,[a] assisted by members of the computing section.

New York.—District hydrographer R. E. Horton,[b] assisted by C. C. Covert. Records have been furnished by the following: E. A. Fisher, city engineer, and John F. Skinner, special assistant engineer, Rochester, N. Y.; T. P. Yates, Waverly, N. Y.; William S. Bacot, Utica, N. Y.; International Paper Company, Fort Edward, N. Y.; Schroon River Pulp and Paper Company, Warrensburg, N. Y.; Duncan Company, R. P. Bloss, Mechanicsville, N. Y.; George Beebe, deputy city engineer, Syracuse, N. Y. Special acknowledgment is made of the interest and assistance of Hon. H. A. Van Alstyne, State engineer, and Henry C. Allen, special deputy State engineer.

Pennsylvania.—District hydrographer N. C. Grover, assisted by members of the computing section. Special acknowledgment is due to John E. Codman for the records of flow of the streams in the vicinity of Philadelphia.

HUDSON RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The principal sources of Hudson River lie in the wildest portion of the Adirondack Mountains, in Essex County, northeastern New York. A number of branches, any one of which might possibly be considered the main stream, form its upper waters; but if the highest collected and permanent body of water be assumed as the true head, then the source of the Hudson becomes Lake Tear-of-the-Clouds, which lies at an elevation of 4,322 feet above tide, in the center of the triangle formed by Mounts Marcy and Skylight and Gray Peak.

The river flows rather irregularly southward until it reaches the northern boundary of Saratoga County, when it makes a sharp turn and flows eastward for about 12 miles by general course, passing through the mountains and forming, as it cuts across the rocky strata, several falls of great height and beauty. At Sandy Hill, just below Glens Falls, it makes another abrupt turn and flows southward, continuing in this direction until it empties into New York Bay.

From Lake Tear-of-the-Clouds to the mouth of the river the distance by water is probably about 300 miles. The total area drained is 13,366 square miles. The river is tidal to Troy, which is also at the head of navigation.

The headwater region is mountainous in character, in general heavily wooded, and dotted with numerous lakes and ponds. The rocks, belonging to the oldest formation and mainly granitic, are either bare or covered only with a layer of spruce duff, humus, and forest litter. The river emerges from the mountain region a few miles west of Glens Falls, and thence to Troy the topography is moderately rolling and the surface soil is chiefly sand. Below Troy the river follows the great depression which extends almost due north and south between New York Bay and the St. Lawrence, flowing in an open valley bordered by well-cultivated lands, which rise with moderate slope from the stream. The Catskill Mountain region is reached 20 or 30 miles below Albany, and thence to the mouth of the river the immediate valley is flanked by high hills, the Highlands of Orange County and the precipitous Palisades being especially noticeable.

The fall in the upper portion of the course is very rapid, amounting to about 64 feet per mile from Lake Tear-of-the-Clouds to North Creek, a distance of about 52 miles. From the mouth of North Creek to the mouth of the Sacondaga the descent is nearly 14 feet per

[a] The office of the district hydrographer for New Jersey and Pennsylvania is at the United States Geological Survey, 1330 F street NW., Washington, D. C.

[b] The office of the district hydrographer for New York is 75 Arcade, Utica, N. Y.

mile, distributed among rapids which diminish in frequency as the Sacondaga is approached. In the succeeding 26 miles to Fort Edward the river descends 418 feet more, but of this 175 feet is comprised within the three abrupt pitches at Palmer, Glens, and Bakers falls, while most of the remainder occurs in the rapids between Jessups Landing and the oxbow above Glens Falls. Between Glens Falls and Troy nearly the entire fall of the river is utilized for the development of water power.

The tributaries of the Hudson are numerous, and many of them are large and important. Indian River, Schroon River, and the Sacondaga unite with the main stream above Glens Falls, and between the latter point and Troy it receives Batten Kill, Fish Creek, Hoosic River, and the Mohawk. The tributaries below Troy include Catskill, Esopus, and Rondout creeks, and Wallkill River from the west, and Kinderhook Creek, Jansen Kill, Wappinger Creek, Fishkill Creek, and Croton River from the east.

Mohawk River, the largest of the tributary streams, rises in the sandy hills south of Booneville, in western New York, about 40 miles from the east end of Lake Ontario. Its uppermost tributaries are fed by large springs, and in addition the stream receives considerable water brought in from the adjacent Black River drainage basin for the supply of the Black River and Erie canals.

The Mohawk flows southward until it reaches the city of Rome, at which point it turns to the east, flowing across the State in a course a little east of south until it enters the Hudson at Cohoes, a few miles above Troy. It has a length by actual course of 140 to 145 miles, and a drainage area, measured at the mouth, of 3,468 square miles.

The immediate valley of the Mohawk is broad and open, at many places a mile or two in width, from which there is a rise, usually gradual but sometimes abrupt, to hills which attain altitudes several hundred feet above the stream. Toward the mouth of the river the valley becomes more contracted and the meadows disappear. The flats which border the stream have a rich alluvial soil, finely adapted to the raising of grass, grains, and broom corn; the more elevated lands are covered with sandy and gravelly loam.

Above Rome the Mohawk flows through a deep gorge in shale rock; from Rome eastward to Little Falls the valley is deeply filled with alluvial deposits, and the flood plains on either side become submerged during freshets, thus acting to some extent as storage reservoirs. At Little Falls the river cuts through a rocky gorge, whose walls rise precipitously 500 or 600 feet.

Below Rome, the fall of the river is small and rather uniform, being made up of long quiet reaches with slight riffles; but at Little Falls this uniformity is broken, and the stream descends in a succession of falls about 45 feet in 2,500. The average fall between Rome and the lower aqueduct at Crescent, a distance of 110.7 miles, is 2.43 feet per mile; thence to the level of slack water above Troy dam there is a farther descent of 149.5 feet in 4.4 miles, but of this 105 feet is included within the improved power at Cohoes.

The principal tributaries of the Mohawk below the source are, successively, Oriskany, West Canada, East Canada, and Schoharie creeks.

The Erie Canal runs parallel to the Mohawk through most of its course below Rome and derives a part of its water supply from the river. Feeder dams for purposes of diversion are located on the river at Delta, Rome, Little Falls, Rocky Rift, and Rexford Flats. A dam at Oriskany Creek also diverts into the canal a portion of the flow of that tributary, as well as waters brought into the Mohawk basin from storage reservoirs located in the upper drainage basin of Chenango River near Hamilton, N. Y. There is also a diversion dam near the mouth of Schoharie Creek, the largest tributary of the Mohawk.

The annual precipitation in the Hudson River basin, as determined by observations at twelve or more stations, is about 37 inches, but the amount is undoubtedly much greater in the elevated country near the headwaters.

The flow of the upper Hudson is controlled to some extent during the dry season by the use of Indian Lake storage reservoir, and the facilities for storage works in this part of the basin are unsurpassed. The entire region is dotted with ponds and lakes, many of them

of large size and fed from extensive drainage areas. Saratoga Lake serves as a regulator of Fish Creek, and there is a small reservoir at the headwaters of the Hoosic. Storage is also extensively developed in the basin of Croton River for the purpose of supplying the city of New York with water. The flow of the Mohawk above the gaging stations at Little Falls and Dunsbach Ferry is modified during the season of canal navigation, extending from about May 1 to December 1.

Except that of the Delaware, the basin of the Hudson contains a greater population in proportion to its size than any other important river basin in the United States. This population is largely concentrated along the great highway of traffic which follows the valley of the Mohawk from the west and then continues down the lower Hudson.

HUDSON RIVER AT FORT EDWARD, N. Y.

This station was established in 1895, in connection with the upper Hudson storage surveys. It is located at the dam of the International Paper Company. The drainage area of the Hudson above Fort Edward is 2,800 square miles, which is 62 per cent of that above the Mechanicsville gaging station, the principal intervening tributaries, Hoosic River and Batten Kill, having drainage areas of 730 and 460 square miles, respectively.

The dam is of framed timber on slate-rock foundation and leaks but little. The crest is straight, very nearly level, and 587.6 feet long. The crest-gage zero stands at the level of the lip of the dam proper. A new and accurate profile of the crest of the dam, obtained in 1903, has been used to determine the discharge since that date.

Flashboards from 15 to 18 inches high are usually maintained on the dam. A record is kept of the height of the flashboards and of the times of their setting and removal. When the flashboards are off the dam the flow is computed by means of coefficients derived from the United States Geological Survey experiments on a model dam of similar cross section; with the flashboards on, the flow is computed by the Francis formula for the thin-edged weir.[a]

In the winter of 1896–97 a flood spillway was cut around the south end of the dam, and the water flows over this when it reaches the level of the crest of the flashboards. The profile of the spillway is very irregular and causes some uncertainty in calculating the flow at times of high water.

During the dry season but little water passes over the dam, the entire flow being employed to drive the turbines, of which there are 62 in the adjoining mill. These are nearly all of modern types, which have been tested at the Holyoke flume. A record is kept of the daily run of each, in hours, as well as of the working head, which is usually 19 feet. The discharge through the turbines is taken from diagrams expressing the flow as a function of the working head and number of wheel-hours run.

In the navigation season water is diverted from the Hudson at the Glens Falls feeder dam, 7 miles above Fort Edward, for the supply of the Champlain Canal.

Information concerning the Hudson at Fort Edward is contained in the annual reports of the State engineer and surveyor of New York, and in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 35, p 58; 47, p 75; 65 p 48, 82, p 100; 97 pp 221-222; 125, pp 19-20.
Discharge: WS 47, p 39.
Discharge, daily: WS 47, p 76; 65 p 49; 82, p 101; 125, p 23.
Discharge, high-water: WS 65, p 50.
Discharge, monthly: Ann 22, iv, p 107; WS 35, p 24; 65, p 49-50; 82, p 102; 125, p 23.
Hydrograph: Ann 22, iv, p 108.

[a] Water-Sup. and Irr. Paper No. 150, U. S. Geol. Survey, 1906.

Daily discharge, in second-feet, of Hudson River at Fort Edward, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,660	2,479	2,070	38,907	11,420	3,279	9,089	8,544	1,841	3,908	4,228	5,928
2	4,323	2,429	2,282	36,435	11,005	3,415	9,560	8,026	2,409	5,093	4,897	3,424
3	3,898	1,984	2,171	30,865	8,313	1,143	14,611	6,505	4,219	3,824	6,255	6,247
4	3,566	2,589	1,908	24,235	9,469	3,390	17,047	5,495	10,263	3,759	3,924	9,639
5	3,028	2,284	1,759	23,445	8,095	3,162	16,681	2,682	17,943	3,623	6,725	8,506
6	2,913	2,251	2,326	26,355	5,572	2,778	14,775	3,701	18,279	3,508	7,024	8,506
7	2,244	2,281	2,160	27,215	7,660	2,663	12,700	4,085	16,958	1,197	6,758	8,631
8	2,109	2,420	2,370	22,785	6,795	4,897	9,846	3,873	14,754	2,180	7,776	7,606
9	3,968	2,568	2,350	19,520	7,073	8,087	9,112	3,007	11,715	3,757	7,457	5,049
10	3,596	2,459	2,055	15,765	6,795	12,007	9,461	3,007	9,810	2,506	7,442	6,486
11	3,604	2,004	1,714	15,375	6,605	9,112	8,147	3,007	9,083	3,007	4,479	5,179
12	3,214	2,133	544	17,185	6,175	7,804	5,311	2,057	7,922	2,756	2,099	3,529
13	3,118	2,257	2,084	18,045	5,779	7,121	5,520	2,771	8,337	5,894	5,829	4,221
14	1,288	2,472	2,055	17,705	6,177	8,525	4,604	3,649	7,537	6,510	5,530	3,823
15	2,188	2,534	2,077	16,065	5,789	7,865	2,110	3,007	6,424	6,130	5,591	3,823
16	3,755	2,523	2,250	17,940	6,175	6,362	4,418	3,759	3,257	6,027	5,059	1,335
17	3,058	2,428	2,245	13,985	5,789	3,521	4,437	5,495	4,647	4,986	5,272	1,702
18	3,058	1,790	1,713	11,555	5,428	11,393	3,512	7,537	7,274	4,364	2,773	2,913
19	2,988	941	444	9,725	4,880	12,035	4,397	4,443	10,811	4,325	4,219	2,663
20	2,713	2,232	3,318	8,095	2,471	12,466	4,222	4,012	12,397	4,574	4,840	3,279
21	1,884	2,307	4,615	7,888	5,060	15,868	4,199	3,472	13,969	4,979	3,372	3,665
22	2,600	2,192	4,496	15,200	5,428	17,986	1,980	3,122	11,138	6,247	3,007	4,009
23	3,093	2,162	4,590	16,990	4,325	16,833	2,773	3,007	10,380	6,666	3,411	2,498
24	3,003	2,397	4,392	16,345	4,325	13,952	1,739	3,007	9,221	5,561	3,372	5,772
25	2,693	1,948	2,734	14,745	3,665	11,078	3,122	3,007	8,549	4,503	1,383	9,099
26	2,462	1,633	4,523	11,420	3,665	11,245	3,122	1,487	6,958	4,503	3,741	4,487
27	2,502	2,307	6,737	11,140	2,009	13,572	3,122	1,702	6,108	4,093	3,513	3,665
28	1,964	2,215	7,603	9,725	5,462	14,470	3,007	2,349	5,378	1,596	3,722	3,415
29	1,567	.....	9,482	8,405	5,147	12,993	1,237	1,911	4,938	5,201	3,257	3,415
30	2,511	.....	12,884	9,810	3,529	11,620	237	1,747	2,521	5,112	4,212	2,605
31	2,511	.....	35,578	.....	3,339	.....	7,361	1,246	.....	4,075	.....	5,891

Estimated monthly discharge of Hudson River at Fort Edward, N. Y., for 1905.

[Drainage area, 2,800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,323	1,288	2,843	1.02	1.18
February	2,589	941	2,222	.794	.827
March	35,578	444	4,436	1.58	1.82
April	38,907	7,888	17,762	6.34	7.07
May	11,420	2,009	5,917	2.11	2.43
June	17,986	1,143	9,021	3.22	3.59
July	17,047	237	6,499	2.32	2.68
August	8,544	1,246	3,701	1.32	1.52
September	18,279	1,841	8,829	3.15	3.51
October	6,666	1,197	4,338	1.55	1.79
November	7,776	1,383	4,686	1.67	1.86
December	9,639	1,335	5,028	1.80	2.08
The year	38,907	237	6,271	2.24	30.36

HUDSON RIVER AT MECHANICSVILLE, N. Y.

A record of the flow of Hudson River at Mechanicsville has been kept by the Duncan Company since December, 1888. The record includes two daily readings of the depth on the crest of the dam, and a continuous record of the run of the water wheels in the adjoining paper mill. The accompanying tables, computed by Mr. R. P. Bloss, the engineer of the company, show the daily and monthly mean flow at Mechanicsville.

The dam of the West Virginia Pulp and Paper Company at Mechanicsville was raised during 1904, a concrete crest and apron being added, so that the dam has now a rounded or ogee profile. A discharge curve has been calculated, using coefficients of discharge derived from United States Geological Survey experiments on models of dams of ogee cross section by Robert E. Horton.

Information concerning the Hudson at Mechanicsville is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 19, iv, pp. 117-118; WS 35, pp 58-59; 47, p 77; 65, pp 50-51; 82, p 102; 97, p 218; 125, pp 22-23.

Discharge: WS 47, p 39.

Discharge, daily: WS 35, pp 59-61; 47, pp 78-79; 65, p 52; 82, p 103; 97, p 218; 125, p 23.

Discharge, monthly: Ann 19, iv, pp 119-122; 20, iv, p 81; 22, iv, pp 109-110; WS 35, p 24; 65, pp 52-53; 82, p 104; 97, p 219; 125, p 23.

Discharge, yearly: Ann 20, iv, p 47.

Hydrographs: Ann 19, iv, p 118; 20, iv, p 80; 21, iv, p 72; 22, iv, p 111; WS 75, p 23.

Daily discharge, in second-feet, of Hudson River at Mechanicsville, N. Y., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,410	5,770	5,770	16,812	29,022	5,616	.....	.....	2,828	14,518	7,754	3,583
2	3,970	4,730	4,930	20,678	28,403	5,610	.....	.....	2,919	14,993	6,708	3,529
3	5,550	4,320	6,030	19,274	26,387	5,596	.....	.....	3,016	13,621	6,065	2,939
4	5,450	4,370	11,180	17,637	25,354	4,518	.....	.....	3,062	10,327	5,867	2,943
5	5,350	3,560	9,130	18,449	22,656	2,949	.....	.....	5,800	9,508	5,636	3,812
6	5,250	3,980	7,968	19,974	20,861	4,965	.....	.....	5,672	8,889	5,042	2,993
7	4,330	5,500	6,732	22,700	18,275	6,377	.....	.....	5,200	.....	5,722	2,927
8	4,910	15,130	16,468	24,412	14,522	7,349	.....	.....	4,578	.....	4,987	3,243
9	4,930	9,910	14,544	32,127	14,437	21,636	.....	.....	5,231	.....	4,773	3,654
10	6,920	8,020	11,611	.....	13,159	20,255	.....	.....	4,665	.....	4,916	2,907
11	5,870	7,680	10,560	36,305	12,286	15,050	.....	.....	5,573	.....	4,213	2,884
12	5,780	7,770	9,305	34,358	11,388	12,748	.....	.....	5,012	.....	3,913	3,685
13	4,730	7,270	8,827	31,054	8,728	11,719	.....	.....	4,499	.....	3,623	2,951
14	4,840	8,060	8,653	26,537	8,512	9,350	.....	.....	3,258	.....	5,335	3,746
15	4,550	7,380	7,880	22,377	6,897	7,787	.....	2,578	15,000	.....	4,230	3,333
16	5,840	5,410	7,378	19,549	8,487	6,825	.....	2,851	14,610	.....	4,337	3,193
17	7,140	5,580	6,910	.....	11,037	5,845	.....	2,739	9,095	.....	4,018	3,177
18	5,640	5,500	6,162	16,039	11,817	5,529	.....	2,548	7,539	.....	4,210	2,726
19	5,510	4,270	5,754	15,429	10,362	4,395	.....	2,564	7,542	.....	3,637	3,346
20	5,850	5,320	7,266	14,473	12,257	4,966	.....	2,578	6,269	.....	3,012	2,983
21	4,600	6,660	7,585	12,921	11,817	4,015	.....	.....	5,491	.....	4,453	3,540
22	3,390	7,310	7,682	11,756	11,369	3,913	.....	12,368	5,470	.....	4,831	3,255
23	9,310	11,850	9,792	11,198	11,245	3,899	2,608	12,914	4,938	.....	3,999	2,993
24	12,970	9,780	13,754	10,700	9,237	3,968	.....	12,926	4,511	.....	4,131	2,996
25	9,340	7,770	14,062	13,984	8,600	3,667	.....	10,603	5,642	.....	3,660	2,874
26	6,800	6,700	22,844	16,836	9,087	2,509	2,630	8,929	7,990	.....	4,374	3,657
27	5,790	6,290	23,362	17,962	8,867	3,074	2,619	7,058	10,412	14,145	3,359	4,622
28	5,190	6,450	20,450	22,387	7,959	3,427	2,630	.....	10,439	12,353	3,860	11,973
29	4,770	6,550	17,471	25,572	6,338	2,844	.....	5,440	9,309	10,646	4,156	8,055
30	5,070	.....	16,058	29,131	6,700	2,585	.....	4,400	14,239	.....	4,432	6,708
31	5,910	.....	16,583	.....	6,934	.....	.....	3,388	.....	8,796	.....	6,341

Daily discharge, in second-feet, of Hudson River at Mechanicsville, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5,340	3,288	2,966	48,877	13,063	4,466	10,394	10,194	4,068	.....	.....	.....
2	6,868	3,903	2,966	44,936	12,466	4,430	8,326	9,940	4,066	6,965	.....	.....
3	6,662	3,800	2,966	38,229	12,112	4,346	14,444	8,610	4,506	6,586	.....	.....
4	4,791	2,927	2,951	31,254	11,105	3,590	13,265	7,025	13,839	6,284	.....	.....
5	4,948	.....	3,574	28,584	11,504	4,623	11,374	5,911	19,544	5,932	.....	.....
6	5,875	4,193	3,067	31,678	11,130	4,719	14,932	4,004	20,704	5,463	.....	.....
7	10,572	3,885	2,951	33,585	9,254	4,273	12,695	5,840	19,846	5,167	.....	.....
8	10,200	3,175	2,951	33,010	10,259	4,203	10,621	4,911	17,573	3,118	.....	.....
9	8,877	3,256	2,951	23,784	9,573	6,959	8,503	5,195	15,110	6,158	.....	.....
10	7,619	3,435	3,028	22,110	9,972	13,724	8,494	5,676	11,274	5,181	.....	.....
11	6,362	3,476	3,018	21,670	9,386	9,955	7,655	5,608	11,855	4,749	.....	.....
12	6,659	4,564	3,846	25,231	8,620	7,928	6,209	7,018	10,564	5,185	.....	.....
13	8,624	3,333	2,982	24,481	8,361	7,632	5,922	4,455	11,462	5,344	.....	.....
14	7,630	3,710	2,981	24,031	7,539	8,053	5,594	5,812	10,535	8,189	.....	.....
15	5,538	3,264	2,982	22,550	8,327	8,186	5,430	5,191	8,853	6,464	.....	.....
16	6,984	3,532	2,951	21,612	7,577	7,173	3,638	6,551	7,432	7,374	.....	.....
17	5,896	4,027	2,951	18,715	8,736	5,888	5,746	7,396	5,870	6,370	.....	.....
18	6,461	3,705	3,291	16,804	7,576	5,709	4,568	8,379	10,617	5,772	.....	.....
19	6,461	5,204	10,067	13,776	7,707	11,067	4,721	5,874	15,721	5,612	.....	.....
20	6,526	3,309	10,714	12,186	7,356	10,867	5,444	4,981	18,214	5,918	.....	.....
21	5,421	2,927	8,967	11,714	5,487	14,426	5,302	6,546	19,708	7,530	.....	.....
22	4,484	3,380	7,166	15,652	7,355	20,395	4,974	5,055	18,703	6,463	.....	.....
23	5,263	3,105	7,067	17,326	6,396	18,664	2,715	4,828	15,835	8,232	.....	.....
24	4,950	2,954	6,994	18,208	5,678	15,422	4,573	4,623	11,297	7,374	.....	.....
25	5,004	3,095	19,276	17,378	5,429	11,915	4,429	4,357	12,294	6,770	.....	.....
26	4,276	4,168	17,788	15,450	5,056	12,407	3,587	2,524	10,278	5,836	.....	.....
27	4,112	3,080	24,161	13,925	5,195	14,109	3,632	2,168	8,810	5,836	.....	.....
28	4,721	2,996	23,881	13,477	4,184	14,932	3,839	3,656	8,037	5,533	.....	.....
29	4,168	.....	24,631	11,715	6,203	14,123	3,749	3,520	7,516	4,119	.....	.....
30	4,213	.....	32,103	11,209	6,007	12,364	3,638	3,436	6,823	6,346	.....	.....
31	3,517	.....	42,838	.....	4,692	.....	6,562	5,265	.....	6,128	.....	.....

NOTE.—Discharges given from July 1 to August 22, 1904, are minimum when all water passed through wheels. On days during that period for which there is no record the discharge was in excess of 2,800 second-feet.

Estimated monthly discharge of Hudson River at Mechanicsville, N. Y., for 1904 and 1905.

[Drainage area, 4,500 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
January	12,970	3,390	5,805	1.29	1.49
February	15,130	3,560	6,858	1.52	1.64
March	23,362	4,930	11,055	2.46	2.84
April (28 days)	36,305	10,700	20,737	4.61	4.80
May	29,022	6,338	13,323	2.96	3.41
June	21,636	2,509	6,765	1.50	1.67
July (4 days)	2,630	2,608	2,622	.583	.067
August (15 days)	12,926	2,548	6,259	1.39	.775
September	15,000	2,828	6,660	1.48	1.65
October (10 days)	14,993	8,889	11,780	2.62	.974
November	7,754	3,012	4,644	1.03	1.15
December	11,973	2,726	3,922	.872	1.00
1905.					
January	10,572	3,517	6,097	1.35	1.56
February	5,204	2,927	3,544	.788	.810
March	42,838	2,951	9,388	2.09	2.41
April	48,877	11,209	22,748	5.06	5.65
May	13,063	4,184	8,171	1.82	2.10
June	20,395	3,590	9,552	2.12	2.37
July	14,932	2,715	6,935	1.54	1.78
August	10,194	2,168	5,631	1.25	1.44
September	20,704	4,066	12,032	2.67	2.98
October 2-31	8,232	3,118	6,067	1.35	1.51

CHAMPLAIN CANAL AT FORT EDWARD AND MECHANICSVILLE, N. Y.

About 7 miles above Fort Edward, at the Glens Falls feeder dam, water is diverted from the Hudson for the supply of the Champlain Canal, and the recorded flow of the river at Fort Edward and Mechanicsville does not, therefore, represent the total natural yield of the drainage basin at those points.

Measurements of flow of Champlain Canal were made during 1905, as follows: August 29, at Saratoga Street Bridge, Mechanicsville, by E. F. Weeks, discharge 84 second-feet; at Notre Dame Street Bridge, Fort Edward, by E. F. Weeks, discharge 78 second-feet. A measurement made at the latter place on September 25, 1905, showed a discharge of 138 second-feet.

FISH CREEK AT BURGOYNE, N. Y.

Fish Creek forms the outlet of Saratoga Lake and has a length of 8 miles below the limit of slack water from the lake. It descends 100 feet in the lower 4 miles of its course, the greater portion of this fall being concentrated at Victory Mills, and enters the Hudson at Schuylerville, where power is developed. It has a total drainage area of 235.8 square miles, as shown by the following table:

Drainage area of Fish Creek. [a]

Point of measurement.	Area in square miles.	
	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
Kayaderosseras Creek above Middle Grove	43.8	43.8
Middle Grove to Ballston Springs	65.8	109.6
Ballston Springs to mouth	85.1	194.7
Saratoga Lake water surface	6.8	.....
Total direct drainage [b]	41.1	235.8

[a] From United States Geological Survey topographic maps, Saratoga, Schuylerville, Schenectady, Glens Falls, Luzerne, and Broadalbin sheets.
[b] Above Brandt's bridge.

A temporary gage was established at Burgoyne station on August 25, 1904, and discontinued June 30, 1905. The gage was attached to the right-hand abutment of Brandt's bridge, and observations of stage were taken once each day by G. R. Warner. Current-meter measurements were made from the bridge. The discharge is not a continuous function of the stage of the stream, however, owing to the fact that grass and aquatic plants growing in the channel cause the velocity to vary with the season. The channel is occasionally cleared of this growth by the water-power users in order to facilitate the flow.

Discharge measurement of Fish Creek at Burgoyne, N. Y., by Horton and Mott, September 25, 1905; gage height, 2.48 feet; discharge, 683 second-feet.

Daily gage height, in feet, of Fish Creek at Burgoyne, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	1.1	.9	.15	8.1	1.6	0.05	17	1.8	.5	.8	3.4	.9	.0
2	1.15	.8	.1	8.0	1.52	.0	18	1.75	.5	.9	3.1	.9	.05
3	1.45	.85	.1	7.6	1.45	.0	19	1.8	.9	1.0	2.9	.85	.03
4	1.45	.9	.15	7.0	1.3	.0	20	1.85	.9	1.0	2.7	.75	−.04
5	1.3	.8	1.8	6.6	1.36	−.08	21	1.7	.95	.9	2.6	.73	−.08
6	1.3	.8	1.1	6.3	1.25	−.17	22	1.3	.95	.9	2.5	.6	.0
7	1.35	.9	.2	6.1	1.3	−.04	23	1.2	1.0	.85	2.4	.7	.1
8	1.5	.9	.2	5.9	1.2	.0	24	1.2	1.0	.95	2.3	.35	.05
9	1.9	.9	.3	4.6	1.15	.0	25	1.1	.9	1.1	2.2	.35	.4
10	1.95	.95	.3	4.3	1.15	.0	26	1.1	.2	1.2	2.13	.3	.22
11	1.9	.9	.35	4.1	1.1	−.05	27	1.0	.2	1.5	1.92	.2	.2
12	1.9	.8	.75	4.1	1.0	−.08	28	.9	.3	2.5	1.8	.18	.....
13	1.95	.75	.8	4.0	1.05	.3	29	.9	.....	3.6	1.73	.15	.28
14	1.95	.8	.85	3.9	.95	.1	30	.85	.....	5.0	1.65	.1	.29
15	1.95	.7	.85	3.7	.9	.05	31	1.0	.....	6.75	.....	.05	.....
16	1.9	.55	.8	3.5	.95	.02							

KAYADEROSSERAS CREEK NEAR SARATOGA LAKE, N. Y.

Kayaderosseras Creek, the chief tributary of Saratoga Lake, drains the highland region lying north and west of the lake and has its source in the range of hills which rises about 800 feet above the general plateau and trend northwest and southeast. The area of the basin, measured at the mouth of the creek, is 194.7 square miles. The topography of the main plateau is moderately rolling, the soil is sandy, and tributaries are sparse, with few marsh or lake areas.

A measurement of the discharge of this creek was made by Robert E. Horton and D. L. Mott on September 25, 1905, at the first bridge above Saratoga Lake. The water surface was 7.93 feet below the top of the upper horizontal tie board, 5 feet from the left-hand end of the bridge, upstream side. The area of the cross section was 301 square feet; the discharge 250 second-feet.

INDIAN RIVER AT INDIAN LAKE, NEW YORK.

A record of the stage of water in Indian Lake reservoir, located in the upper Hudson River basin, as described in preceding reports, has been continued. The reservoir gates were open during the greater portion of the year, the closed period extending from April 1 to July 26. The reported stage of water in the reservoir is shown in the accompanying table.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 47, pp 71-72; 65, pp 42-44; 82, p 98; 97, p 222; 125, p 24.
Stage of water: 47, p 72; 65, p 44; 82, p 99; 97, p 223; 125, p 24.

Stage of water, in feet, in Indian Lake reservoir, New York, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	17.16	13.16	7.84	10.66	26.33	31.04	35.12	34.5	33.62	33.58	32.58
2	16.92	12.92	7.66	11.46	26.66	31.08	35.58	34.42	33.5	33.42	32.51
3	16.79	12.66	7.46	12.04	27.0	31.04	36.0	34.25	33.84	33.25	32.42
4	16.62	12.46	7.25	12.75	27.33	31.21	35.96	34.08	35.08	33.0	32.33
5	16.42	12.25	7.04	13.5	27.62	31.33	35.66	34.08	36.08	32.92	32.25
6	16.42	12.08	6.84	14.42	27.92	31.42	35.33	34.08	36.16	32.75	32.21
7	16.46	11.88	6.66	15.08	28.16	31.5	35.16	34.08	36.0	32.5	32.16
8	16.46	11.66	6.50	15.58	28.37	31.75	35.0	34.08	35.84	32.25	32.12
9	16.33	11.46	6.33	15.58	28.58	32.0	34.84	34.0	35.66	32.08	32.08
10	16.21	11.25	6.08	16.33	28.75	32.16	34.58	34.0	35.5	32.16	31.96
11	16.12	11.04	5.84	16.66	28.92	32.37	34.42	34.0	35.33	32.25	32.84
12	16.0	10.84	5.58	17.33	29.04	32.58	34.25	34.04	35.16	32.5	31.66
13	15.92	10.66	5.33	18.0	29.16	32.75	34.16	34.08	35.0	32.71	31.54
14	15.84	10.5	5.08	18.58	29.29	32.92	34.25	34.08	34.92	32.92	31.42
15	15.75	10.33	4.84	18.92	29.46	33.0	34.16	34.08	34.84	33.0	31.58
16	15.66	10.16	4.58	19.16	29.58	33.08	34.21	34.12	34.75	33.08	31.66
17	15.58	10.0	4.33	19.33	29.71	33.75	34.16	34.08	34.66	33.16	31.71
18	15.42	9.84	4.33	19.5	29.84	34.33	34.08	34.04	34.84	33.29	31.75
19	15.25	9.58	4.33	19.71	30.0	34.66	34.16	34.0	35.08	33.5	31.75
20	15.08	9.42	4.33	19.92	30.08	35.08	34.16	33.96	35.25	33.79	31.75
21	15.0	9.25	4.33	20.5	30.16	35.33	34.16	33.0	35.29	34.0	31.75
22	14.92	9.08	4.33	21.66	30.25	35.5	34.16	33.96	35.29	34.08	31.75
23	14.84	8.92	4.84	22.5	30.33	35.46	34.21	33.96	35.16	34.21	31.79
24	14.71	8.71	5.08	23.0	30.42	35.42	34.08	33.96	35.12	34.33	31.84
25	14.58	8.5	5.5	23.42	30.5	35.25	34.08	33.96	34.84	34.37	31.88
26	14.46	8.33	5.84	23.84	30.58	35.46	34.08	33.92	34.71	34.42	31.92
27	14.33	8.16	6.21	24.33	30.66	35.42	34.08	33.92	34.5	34.33	31.96
28	14.08	8.0	6.66	24.75	30.75	35.42	34.08	33.92	34.25	33.92	32.0
29	13.84	.....	7.29	25.33	30.84	35.33	34.04	33.92	34.0	33.54	32.08
30	13.58	.....	8.33	25.88	30.92	35.25	34.25	33.84	33.75	33.16	32.25
31	13.42	.....	9.42	.....	31.0	.....	34.5	33.75	.....	32.84	.....

HOOSIC RIVER AT BUSKIRK, N. Y.

Hoosic River has its sources on the west slope of the Hoosac Mountains in Vermont and Massachusetts. Two head branches, one flowing southward, the other northward along the west slope of this range, unite at North Adams, Mass., and the stream then flows northwestward, entering the Hudson 3 miles north of Mechanicsville.. Above Buskirk the drainage basin is rugged and precipitous, the distribution of tributaries affording rapid concentration of the run-off from the steep rock slopes. The ridges are sparsely wooded. The soil in the valleys is generally firm and tenacious. The general elevation of the valley at the junction of the headwaters is 1,000 feet. Numerous dams, affording power for textile, agricultural implement, and other industries are scattered throughout the length of the stream from North Adams to Schaghticoke. The drainage basin contains no important lakes and but one storage reservoir, at Farnam, near the head of South Branch.

South of Hoosic River the State boundary follows the Taconic Ridge, which forms the divide between the Hoosic in Massachusetts and the Little Hoosic in New York.

A gaging station was established September 25, 1903, at the highway bridge in Buskirk village. The channel is straight near the gaging station. The banks are high and seldom overflow. The current is exceptionally smooth, but is rather slow during low water. A standard chain gage is attached to the covered wooden highway bridge. The length of the chain is 28.17 feet. The gage is read twice each day by Bert C. Henry. A bench mark is located on the upstream corner of the left abutment; elevation, 36.03 feet above gage datum.

Information concerning this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905, and in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp. 219-220; 125, pp. 24-25.
Discharge: 97, p. 220; 125, p. 25.
Gage heights: 97, p. 221; 125, p. 26.

Discharge measurements of Hoosic River at Buskirk, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 28	H. R. Beebe	144	1,095	5.52	7.00	6,035
March 29	do	144	1,091	5.63	6.98	6,141
August 8	C. C. Covert	127	421	1.19	2.18	499
August 9	do	125	404	1.03	1.92	417

Daily gage height, in feet, of Hoosic River at Buskirk, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	3.68	2.95	7.25	2.62	1.79	2.26	3.14	3.0	2.22	2.0	3.7
2	2.82	3.5	2.9	5.5	2.58	1.77	2.14	2.44	2.52	2.2	1.78	3.28
3	3.05	3.4	2.98	4.88	2.55	1.87	2.78	2.32	5.02	2.25	1.72	8.3
4	2.92	3.38	2.88	4.72	2.6	1.69	2.28	2.14	5.85	2.4	1.88	7.45
5	4.38	3.48	2.88	5.08	2.42	1.75	2.18	2.14	5.25	2.28	2.05	4.85
6	4.35	3.48	2.95	5.78	2.45	1.87	2.11	1.72	4.05	2.25	2.05	4.3
7	5.32	3.62	3.0	4.92	2.45	2.17	2.08	2.22	3.6	2.08	2.4	3.92
8	5.4	3.58	2.9	4.3	2.58	1.99	1.97	2.12	3.25	1.98	2.32	3.55
9	4.1	3.45	3.0	3.6	2.52	2.02	1.87	1.88	3.15	1.9	2.3	3.4
10	3.6	3.52	3.18	3.9	2.45	1.82	1.97	1.9	2.65	1.92	2.1	3.05
11	3.38	3.42	3.18	5.32	2.35	1.72	1.95	2.6	2.62	1.88	2.08	2.9
12	3.62	3.38	3.42	5.9	2.4	1.69	1.93	3.72	2.52	2.65	1.95	2.92
13	4.6	3.4	3.35	4.95	2.38	1.77	1.77	3.02	2.48	2.48	2.02	2.82
14	3.82	3.32	3.4	4.45	2.33	1.82	1.93	2.55	2.95	2.2	1.98	2.82
15	3.15	3.3	3.28	4.3	2.35	1.86	1.7	2.4	2.72	2.05	1.88	2.55
16	3.35	3.32	3.32	3.78	2.58	1.68	1.7	3.38	2.52	2.1	1.9	2.65
17	3.25	3.38	3.38	3.7	2.45	1.54	1.87	3.45	2.45	2.1	1.95	2.5
18	3.0	3.5	3.85	3.38	2.48	1.66	1.77	3.18	4.0	2.02	1.95	2.68
19	2.78	3.32	8.65	3.12	2.45	2.08	1.83	2.55	4.8	2.15	2.0	2.5
20	2.68	3.35	5.45	3.0	2.3	2.18	1.87	2.18	3.98	2.48	1.95	2.45
21	2.8	3.3	4.12	3.48	2.38	2.98	1.75	2.32	4.22	2.62	1.85	2.5
22	2.52	3.2	3.55	3.68	2.18	5.31	1.67	2.22	3.38	2.2	1.85	3.15
23	2.58	3.1	3.52	3.2	2.05	3.91	1.53	2.2	3.12	2.28	1.75	3.25
24	4.8	3.02	3.7	3.1	2.05	3.28	1.65	2.12	2.88	2.2	1.78	2.9
25	4.55	3.12	9.85	3.02	2.0	2.66	1.83	1.98	2.75	2.25	1.68	2.62
26	4.0	3.02	6.7	2.78	1.85	3.44	1.9	2.02	2.68	2.05	1.7	2.48
27	4.12	3.12	7.95	2.8	2.02	3.44	1.83	1.98	2.55	2.05	1.95	2.5
28	4.32	2.92	7.15	2.65	1.95	3.01	1.8	2.05	2.4	2.0	1.88	2.45
29	4.28	.....	7.12	2.55	1.82	2.66	1.67	1.95	2.4	1.88	2.78	2.65
30	3.95	.....	8.72	2.78	1.37	2.44	4.77	2.0	2.3	2.07	5.78	3.22
31	3.75	.....	8.95	.....	1.45	.....	4.02	4.1	.....	2.0	.....	2.62

NOTE.—River frozen entirely across from January 24 to March 18, inclusive. During this period the gage was read to the surface of the water through a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 1	3.7	3.85	0.6
February 4	3.4	3.6	.75
February 11	3.45	3.6	1.0
February 18	3.7	3.85	1.5
February 25	3.15	3.4	1.5
March 4	2.9	3.05	1.8
March 11	3.15	3.2	1.9
March 18	3.75	3.75	1.9

Station rating table for Hoosic River at Buskirk, N. Y., from September 25, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	140	2.50	704	3.60	1,614	4.60	2,735
1.50	176	2.60	769	3.70	1,716	4.70	2,860
1.60	216	2.70	837	3.80	1,822	4.80	2,985
1.70	260	2.80	909	3.90	1,930	4.90	3,110
1.80	308	2.90	985	4.00	2,040	5.00	3,240
1.90	359	3.00	1,065	4.10	2,150	5.50	3,905
2.00	412	3.10	1,149	4.20	2,265	6.00	4,600
2.10	467	3.20	1,236	4.30	2,380	7.00	6,080
2.20	524	3.30	1,326	4.40	2,495	8.00	7,630
2.30	582	3.40	1,419	4.50	2,615	9.00	9,230
2.40	642	3.50	1,515				

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1903–1905. It is fairly well defined between gage heights 1.6 feet and 7 feet. The table has been extended beyond these limits

Estimated monthly discharge of Hoosic River at Buskirk, N. Y., 1903–1905.

[Drainage area, 579 square miles.]

Month.	Discharge in second-feet			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September 25–30	401	238	310	0.535	0.119
October	5,108	238	983	1.70	1.96
November	1,854	339	626	1.08	1.20
December	4,544	339	1,143	1.97	2.27
1904.					
January 24–31	1,996	661	970	1.68	.500
February 1–19	7,460	484	1,635	2.82	1.99
March 24–31	8,046	1,496	3,141	5.42	1.61
April	4,208	1,115	2,171	3.75	4.18
May	2,472	642	1,165	2.01	2.32
June	13,680	434	1,528	2.64	2.94
July	654	169	322	.556	.641
August	1,065	158	290	.501	.578
September	3,986	172	584	1.01	1.13
October	4,194	473	951	1.64	1.89
November	756	308	531	.917	1.02
December	4,890	456	1,297	2.24	2.58
1905.					
January 1–23	3,770	717	1,591	2.75	2.35
March 19–31	10,630	1,535	5,678	9.81	4.74
April	6,468	736	2,244	3.88	4.33
May	783	130	576	.995	1.15
June	3,648	192	694	1.20	1.34
July	2,948	188	512	.884	1.02
August	1,737	270	725	1.25	1.44
September	4,390	582	1,420	2.45	2.73
October	803	349	509	.879	1.01
November	4,292	251	537	.927	1.03
December	8,110	673	1,533	2.65	3.06

NOTE.—River frozen January 1–23, February 20 to March 23, 1904, and January 24 to March 18, 1905; no estimate made.

MOHAWK RIVER AT LITTLE FALLS, N. Y.

This gaging station is located at the lower (Gilbert's) dam at Little Falls, N. Y. The dam is of masonry, having the form of a circular arc, and furnishes power for the Astoronga Knitting Mill and the mill of the Little Falls Paper Company. In the Astoronga Knitting Mill are two turbines, built by T. H. Risdon & Co., Mount Holly, N. J. In the mill of the paper company are three Camden turbines and one 60-inch Day turbine, built in Little Falls.

There are three dams at Little Falls. The upper one is a State dam, diverting water for the supply of the Erie Canal; the lower two are used for water-power development. The gage record kept at the lower dam shows the amount of water flowing downstream from Little Falls, but does not include the diversion at the State dam above the gaging station, and hence does not represent the total yield from the tributary drainage area of 1,306 square miles.

In calculating the discharge for 1905 use has been made of the experiments of the United States Geological Survey at Cornell University in 1903 on flow over dams.

Information concerning this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905, and in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 35, p 51; 47, p 52; 65, p 162; 82, p 92; 97, p 196; 125, pp 26-27.
Discharge: WS 47, pp 39, 52-53; 65, pp 162, 163.
Discharge, daily: WS 35, p 51; 47, pp 54-55; 65, p 163; 82, p 93; 125, pp 27-28.
Discharge, flood: WS 47, p 53; 65, p 165.
Discharge, low-water: WS 47, p 54; 65, p 165.
Discharge, monthly: Ann 22, iv, p 94; WS 35, p 24; 65, p 164; 82, p 94; 125, pp 28-29.
Hydrographs: Ann 21, iv, p 67; 22, iv, p 95.

Daily discharge, in second-feet, of Mohawk River at Little Falls, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,519	1,137	1,063	18,334	5,238	1,142	1,725	3,229	2,170	986	3,809	5,325
2	4,375	1,178	1,096	13,521	3,885	1,027	3,648	1,728	1,397	1,027	5,310	3,569
3	4,258	1,137	1,094	9,623	2,665	1,178	7,514	1,716	5,133	2,426	4,037	13,650
4	4,183	1,067	1,099	8,722	3,231	903	7,351	1,300	15,171	2,180	3,695	10,989
5	3,959	651	651	12,051	2,839	1,184	4,568	1,029	18,287	1,028	3,454	8,709
6	3,579	995	1,024	12,932	4,460	1,668	2,696	1,028	11,325	1,280	4,311	6,714
7	2,047	1,098	1,059	11,245	5,603	2,175	2,117	3,735	7,758	929	6,328	5,808
8	2,155	1,136	1,060	8,446	3,520	3,137	1,731	2,358	6,059	1,030	6,178	4,012
9	3,585	1,134	1,060	6,053	3,208	3,260	1,792	1,518	3,744	892	5,155	3,050
10	2,098	1,062	1,214	5,515	2,513	3,196	1,525	1,265	2,522	953	3,953	2,854
11	1,786	1,029	1,065	7,056	1,926	613	1,229	1,179	2,125	827	3,159	2,045
12	1,795	770	511	9,347	2,074	2,640	1,583	1,727	2,936	4,245	2,912	2,126
13	3,472	1,031	921	8,371	1,599	2,407	1,438	3,642	3,521	5,434	2,767	2,126
14	3,414	1,026	885	8,351	1,801	2,169	2,223	2,936	2,472	4,950	3,005	2,076
15	2,403	1,061	921	6,847	2,122	1,518	2,823	1,972	1,866	3,597	2,407	1,074
16	2,157	1,043	886	5,150	1,862	1,270	1,863	5,233	1,938	2,605	2,181	980
17	1,944	1,173	921	3,715	1,267	1,278	1,576	5,081	1,792	2,138	2,229	789
18	1,621	1,132	889	3,009	1,349	3,753	1,716	3,536	4,651	2,031	2,176	1,283
19	1,874	730	1,923	2,588	1,926	4,381	1,757	2,002	5,981	2,024	2,211	1,351
20	1,921	1,173	5,109	2,701	1,820	4,381	2,518	1,681	5,049	5,973	1,863	1,658
21	1,649	1,173	5,211	4,224	1,337	6,965	1,975	1,399	4,821	5,620	1,480	4,758
22	1,310	1,079	5,203	10,223	1,521	7,306	1,511	1,273	3,545	3,964	1,437	6,393
23	1,481	1,079	5,429	7,380	1,273	6,244	1,118	1,142	2,756	3,359	1,523	5,577
24	1,438	1,079	4,954	5,613	1,298	5,201	1,182	992	2,016	2,778	1,667	3,452
25	1,384	1,251	6,308	4,584	1,141	3,597	1,298	917	1,665	2,411	2,105	3,452
26	1,384	730	9,180	4,680	1,026	6,076	1,300	786	1,608	2,082	2,267	2,312
27	1,099	1,132	14,921	5,060	1,313	6,075	1,072	571	1,436	1,870	2,172	2,349
28	1,197	1,132	20,883	4,829	1,488	6,154	1,027	797	1,301	1,736	1,973	2,013
29	900	.....	14,219	4,825	1,332	3,342	958	960	1,272	1,748	4,712	2,285
30	1,178	.....	18,341	6,281	1,204	2,115	809	1,222	1,112	1,399	7,694	3,768
31	1,176	.....	19,629	.....	1,300	.....	4,346	2,869	.....	1,441	.....	4,670

Estimated monthly discharge of Mohawk River at Little Falls, N. Y., for 1905.

[Drainage area, 1,306 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,519	900	2,301	1.76	2.03
February	1,251	651	1,051	.805	.838
March	20,883	511	4,798	3.67	4.23
April	18,334	2,588	7,376	5.65	6.30
May	5,603	1,026	2,230	1.71	1.97
June	7,306	613	3,214	2.46	2.74
July	7,514	809	2,258	1.73	1.99
August	5,233	571	1,962	1.50	1.73
September	18,287	1,112	4,248	3.25	3.63
October	5,973	827	2,420	1.85	2.13
November	7,694	1,437	3,272	2.51	2.80
December	13,656	789	3,910	2.99	3.45
The year	20,883	511	3,253	2.49	33.84

MOHAWK RIVER AT DUNSBACH FERRY BRIDGE, NEW YORK.

This station was established March 12, 1898, for the primary purpose of checking a system of levels for the United States Board of Engineers on Deep Waterways, by D. J. Howell, civil engineer, who has furnished the earlier portion of the record. The station is located at the dam of the West Troy Water Company, one-fifth mile above Dunsbach Ferry Bridge, 9 miles from the mouth of the river. No record was kept from April 1, 1899, to August 1, 1900.

The dam is of masonry, with a flat granite crest 5.5 feet wide. It is in two sections, situated on opposite sides of an island of Hudson River shale. The left wing, at the upper end of the island, has a crest length of 380 feet; the right wing, 500 feet downstream, at the foot of the island, has a crest 280 feet long. The dam was rebuilt in 1903 and a new profile obtained.

During high water the current of the stream through the cross section of the channel leading to the lower dam has a velocity of several feet per second. The head due to this velocity has been added to the observed head as a correction for velocity of approach to the lower dam. The upper dam is situated 450 feet upstream from the crest gage.

The crest-gage is attached to the timber cribbing 50 feet above the lower section of the dam, with its zero mark at an elevation of 172.00 feet referred to the United States Deep Waterways datum. Gage readings are taken twice daily at intervals of about twelve hours by Robert Wilson. The mean of the two daily readings is used in computing the flow.

The discharge over the dam has been calculated by means of the weir formula, using coefficients derived from the United States Geological Survey experiments.

In the pumping station adjoining the dam are two turbines of the old American type, one 66 inches and the other 75 inches in diameter. A new 54-inch Victor turbine was installed during 1902. The discharge is calculated from the recorded daily run of the water wheels and the working head. The turbines drive pumps taking water from the river for water-supply purposes at the rate of about 1,500,000 gallons per day, equivalent to a continuous flow of 2.25 second-feet.

Daily discharge, in second-feet, of Mohawk River at Dunsbach Ferry Bridge, New York, for 1905.

Day.	Jan.	Feb.[a]	Mar.[a]	Apr.	May.	June.[b]	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8,440	1,980	841	38,440	8,440	2,760	6,680	5,490	4,620	2,760	3,720	12,270
2	8,720	1,790	841	32,780	8,720	2,760	7,430	5,060	4,190	2,930	7,400	8,360
3	9,560	1,790	896	30,020	5,920	2,710	10,960	3,590	5,060	3,760	7,680	16,040
4	7,180	1,790	951	25,820	5,270	2,600	11,240	2,930	17,080	3,980	6,170	35,030
5	5,490	1,680	896	20,350	5,270	2,430	10,120	2,270	27,480	3,980	5,700	21,700
6	4,840	1,610	951	22,250	6,170	3,260	7,430	1,760	25,820	3,590	5,490	14,610
7	5,060	1,590	951	27,070	6,680	4,620	4,620	2,600	27,080	2,930	7,430	17,780
8	8,440	1,640	951	25,020	7,180	6,170	3,760	5,700	10,680	2,430	10,960	9,480
9	11,550	1,760	951	12,800	6,930	5,920	3,760	3,430	8,440	2,270	10,400	7,420
10	10,960	1,870	1,180	13,730	5,880	4,840	3,590	2,600	6,170	2,100	8,190	6,090
11	7,940	1,640	1,640	13,420	5,410	3,980	3,260	2,100	5,060	2,100	6,420	5,620
12	5,700	1,520	1,520	21,860	4,540	5,700	3,430	2,100	4,410	3,430	5,700	5,490
13	5,490	1,330	1,410	20,300	4,540	5,490	3,260	2,930	6,420	10,120	5,490	5,060
14	5,270	1,330	1,520	17,760	4,190	4,620	2,760	4,620	6,170	9,280	5,060	5,060
15	5,060	1,410	1,640	13,420	4,190	3,980	3,260	4,620	4,840	8,190	4,840	4,620
16	4,620	951	1,760	11,860	4,840	3,430	4,840	6,170	3,980	6,420	4,620	4,410
17	4,410	951	1,870	10,120	4,840	3,100	4,840	13,730	3,430	4,840	4,190	3,760
18	3,980	867	1,870	8,190	4,190	3,100	2,760	8,720	5,700	4,190	3,590	3,260
19	3,760	1,100	2,100	7,680	3,760	3,430	4,430	5,700	14,040	4,410	3,100	3,100
20	3,590	1,180	13,110	6,680	3,760	6,420	2,760	3,430	12,170	8,440	3,100	3,260
21	3,430	1,410	14,350	6,420	3,760	6,680	3,430	2,930	12,480	9,280	2,930	4,410
22	4,100	1,300	12,800	7,680	3,590	15,370	2,930	2,760	9,560	8,190	2,760	7,180
23	4,100	1,180	16,060	10,400	3,260	12,480	2,600	2,600	6,930	6,680	2,760	13,420
24	2,930	1,050	15,030	11,860	3,100	10,400	2,100	2,270	5,490	5,700	2,600	10,120
25	2,760	951	17,760	10,120	3,000	7,940	2,100	2,100	4,620	5,060	2,430	9,280
26	2,680	902	39,900	8,190	2,930	6,420	2,100	1,870	3,760	4,410	2,720	7,430
27	2,680	757	36,540	8,440	2,760	14,350	2,270	1,760	3,430	3,760	3,180	6,420
28	2,730	778	44,890	8,190	2,760	11,240	2,020	1,720	3,100	3,430	3,900	5,060
29	3,050	.....	39,400	8,440	2,760	9,280	1,870	1,640	3,100	3,430	4,540	5,270
30	3,040	.....	41,380	8,720	2,760	6,930	1,870	1,640	2,760	3,100	15,980	8,720
31	3,020	.....	41,380	.....	2,600	.....	1,640	2,680	.....	3,930	.....	8,190
Mean	5,309	1,361	11,527	15,601	4,645	6,080	4,197	3,662	8,602	4,778	5,435	8,985

[a] Approximate. Some ice obstructions.
[b] Dam undergoing repairs. Flow slightly obstructed after June 6.

Estimated monthly discharge of Mohawk River at Dunsbach Ferry Bridge, New York, for 1905.

[Drainage area, 3,440 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	11,550	2,680	5,309	1.54	1.78
February	1,980	757	1,361	.396	.412
March	44,890	841	11,530	3.35	3.86
April	38,440	6,420	15,600	4.53	5.05
May	8,720	2,600	4,645	1.35	1.56
June	15,370	2,430	6,080	1.77	1.98
July	11,240	1,640	4,197	1.22	1.41
August	13,730	1,640	3,662	1.06	1.22
September	27,480	2,760	8,602	2.50	2.79
October	10,120	2,100	4,778	1.39	1.60
November	15,980	2,430	5,435	1.58	1.76
December	35,030	3,100	8,985	2.61	3.01
The year	44,890	757	6,682	1.94	26.43

ORISKANY CREEK AT COLEMAN, N. Y.

A gaging station was established at Wood Road Bridge, 1 mile above the village of Oriskany, June 5, 1901. This station was discontinued November 30, 1904, a new station having been established at Coleman, 1 mile upstream, where a cableway was erected for use in making current-meter measurements during high water. Observations at the cable station were begun August 13, 1904.

The stream flows in a single channel. The bed is composed of gravel and bowlders. There is a flood plain at the left bank.

A staff gage is attached to piling and braced to trees along the bank. It is read twice each day by Peter Gambel. The bench mark is the top of a spike driven into the root of a basswood tree which supports the right-hand end of the cable; elevation, 8.83 feet above the zero of the gage.

A dam at Reeder's mills, one-fourth mile upstream from the cable station, affords opportunity for checking the freshet discharge and is also some protection against ice, which very seriously obstructs Oriskany Creek in winter.

Oriskany Creek receives the inflow from storage reservoirs at the head of Chenango River, in addition to the yield of its natural drainage area, which comprises about 140 square miles above the gaging station. During the navigation season the flow of the creek is diverted, as a whole or in part, at the State dam below the gaging station.

Information in regard to this station is contained in Water-Supply Paper No. 35 of United States Geological Survey: Description, p. 47; discharge, monthly, p. 24.

Discharge measurements of Oriskany Creek at Coleman, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
July 7	H. R. Beebe	75	121	2.13	1.18	258
August 26 [a]	R. E. Horton	70	94	1.14	.68	108
August 26 [a]	do	70	86	1.01	.55	87
September 1	C. C. Covert	79	123	1.89	1.34	234
September 1	C. J. Wood	72	123	1.82	1.28	225

[a] Wading below cable.

Daily gage height, in feet, of Oriskany Creek at Coleman, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.35	2.2	.....	.....	0.82	1.1	1.2	1.25	0.92	1.08	1.48
2	.....	2.75	2.1	.....	.....	.85	2.32	1.08	1.02	.92	1.5	1.32
3	.....	2.9	2.3	.....	.....	.68	2.25	.92	2.55	2.0	1.35	3.7
4	.....	2.47	2.23	.....	.....	.72	1.55	.75	4.8	1.28	1.22	2.35
5	1.85	2.4	2.25	.....	.....	.85	1.5	.68	2.7	1.08	1.08	2.1
6	2.17	.....	2.3	.....	.....	1.08	1.3	1.05	2.35	1.0	1.58	1.95
7	1.8	2.45	2.2	.....	.....	1.02	1.25	1.38	2.15	.9	1.7	1.8
8	1.73	2.57	2.33	.....	.....	1.55	1.05	1.0	1.85	.92	1.7	1.85
9	1.63	.....	2.3	.....	1.25	1.12	.98	.78	1.5	.9	1.6	1.78
10	1.55	2.53	2.27	.....	1.15	.7	.9	.7	1.45	.9	1.35	1.72
11	1.73	2.57	2.23	.....	1.1	1.05	.85	.75	1.4	.98	1.18	1.72
12	1.9	.....	2.17	.....	1.1	1.2	1.0	.62	2.45	3.0	1.18	1.48
13	3.35	.....	2.17	.....	.65	1.15	1.15	1.55	1.85	2.15	1.12	1.48
14	3.2	2.57	2.15	.....	1.3	.92	1.32	1.02	1.6	1.72	1.15	1.45
15	3.25	2.5	2.1	.....	1.68	.82	1.28	1.4	1.42	1.38	1.02	1.45
16	3.4	2.65	1.93	.....	1.32	.75	.98	3.05	1.42	1.28	1.22	1.28
17	3.25	2.45	2.2	.....	1.3	.88	.9	1.9	1.32	1.2	1.4	1.38
18	3.1	2.45	2.4	.....	1.35	1.15	.72	1.38	2.05	1.15	1.28	1.48
19	3.15	2.47	6.35	.....	1.35	1.72	1.08	1.08	1.62	2.1	1.28	1.28
20	2.95	2.5	5.7	.....	1.2	2.3	.92	1.02	1.62	1.7	1.35	1.22
21	1.53	2.57	4.7	.....	1.12	3.75	.78	1.02	1.4	1.5	1.22	1.65
22	1.5	2.37	4.3	.....	1.05	2.8	.68	.95	1.32	1.38	1.05	3.38
23	1.45	2.33	3.95	.....	1.05	1.82	.55	.88	1.22	1.32	1.05	2.15
24	1.53	2.3	5.35	.....	1.05	1.45	.75	.8	1.12	1.25	1.1	1.98
25	2.03	2.35	7.6	.....	.98	1.22	.72	.85	1.08	1.12	1.3	1.68
26	1.95	2.3	.....	.....	.98	4.4	.48	.58	1.02	1.1	1.22	1.78
27	2.1	2.23	.....	.....	1.08	2.35	.62	.78	1.05	1.1	1.22	1.62
28	2.45	2.27	.....	.....	.98	1.85	.65	.78	.98	1.02	1.18	1.58
29	2.43	.....	.....	.....	.95	1.5	.5	.9	.82	1.05	2.12	2.22
30	2.27	.....	.....	.....	.88	1.22	.62	1.45	.9	1.05	1.82	2.2
31	2.23	.....	.....	.....	.82	.....	1.55	1.88	.....	1.02	.....	1.78

NOTE.—Ice conditions January 1 to March 26, approximately; stream frozen entirely across most of the time. Thickness of ice varied from 0.1 to 1.3 feet.

ORISKANY CREEK AT STATE DAM, NEAR ORISKANY, N. Y.

Readings were taken from a reference point on the right-hand abutment of the State dam to determine the freshet discharge, beginning on the day when the ice left the stream in the spring of 1905, and continuing until the opening of the feeder gates for the supply of the Erie Canal. The dam is in good condition, and a discharge curve has been prepared from the data of a survey and profile.

A measurement of the leakage of this dam was made by means of the flow through a rectangular channel, August 26, 1905, and an allowance of 10 second-feet for leakage has been calculated in the discharge.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 35, pp 47–48; 47, pp 45–46; 65, pp 145–146, 147–148; 82, p 79; 97, p 217; 125, pp 32–33.
Discharge: WS 47, pp 39, 46; 65, p 148; 82, pp 79–80; 97, p 217; 125, p 33.
Discharge, daily: WS 35, p 48; 47, pp 46–47; 125, p 34.
Discharge, monthly: Ann 22, iv, p 88; WS 35, p 24; 65, p 147; 125, p 35.
Gage heights: WS 65, p 149; 82, p 80; 125, pp 33–34.
Hydrographs: Ann 21, iv, p 66; 22, iv, p 89.

Daily discharge, in second-feet, of Oriskany Creek at State dam, near Oriskany, N. Y., during spring freshet season 1905.

Day.	Mar.	Apr.	Day.	Mar.	Apr.	Day.	Mar.	Apr.
1		1,080	12			23	590	
2		340	13			24	1,500	
3		130	14			25	3,100	
4		105	15			26	1,580	
5		1,080	16			27	1,300	
6		905	17			28	1,080	
7		960	18			29	520	
8		300	19	1,530		30	1,030	
9			20	1,120		31	1,250	
10			21	960				
11			22	380				

STARCH FACTORY CREEK NEAR NEW HARTFORD, N. Y.

Starch Factory Creek is tributary to the Mohawk near Utica, N. Y. Its drainage basin, which includes Graefenberg Creek and reservoir, is shown on the Utica sheet of the United States Geological Survey topographic atlas, from which the following drainage areas have been taken:

Drainage areas of Starch Factory Creek.

	Square miles.
Above Graefenberg reservoir dam [a]	0.45
Above gaging weir	3.40
Above Savage reservoir dam	3.81
Above mouth	6.60

The region tributary to Starch Factory Creek consists of cleared farm land, chiefly sodded slopes, rising from the stream to the divide on either side in a distance of about a mile from the main stream, which flows in a gulf 300 feet below the level of the general plateau. A few small lateral creeks drain the more remote portions of the area.

A gaging weir was erected on this creek above the head of the former Savage reservoir May 26, 1903. The weir has a horizontal iron crest 6 feet in length, with end contractions. The weir gage is placed 6 feet upstream from the weir and is observed twice daily. The discharge is calculated by the Francis formula. In extreme freshets the discharge is observed at the masonry intake dam a short distance downstream.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 206; 125, p 35.
Discharge: 97, p 206.
Discharge, daily: 97, p 207; 125, p 36.
Discharge, monthly: 97, p 207; 125, p 37.

[a] The yield is developed from this area by tiling from springs.

Daily discharge, in second-feet, of Starch Factory Creek near New Hartford, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.02	0.76	0.66	16.20	2.45	1.43	.....	13.32	1.77	1.16	8.24	2.49
2	17.50	.76	.66	10.40	2.39	1.55	.....	13.32	1.28	1.40	3.26	3.26
3	6.04	.86	.66	9.63	2.52	1.68	.....	13.32	28.30	2.33	2.94	25.20
4	4.16	.76	.66	12.45	3.54	1.19	.....	9.01	159.00	2.64	2.94	9.12
5	3.62	.71	.66	32.10	2.60	.96	.....	7.39	13.94	2.05	2.94	4.45
6	3.46	.66	.66	25.00	3.22	2.52	.....	7.39	11.46	1.77	10.99	5.37
7	7.57	.66	.66	8.13	3.51	2.67	.....	7.39	22.02	1.77	6.14	5.18
8	4.60	.66	.66	4.51	3.46	5.25	.....	[a]15.40	9.12	1.77	5.37	5.56
9	2.52	.66	.66	7.05	4.97	2.67	[b]3.88	15.40	3.92	1.64	11.23	5.75
10	2.23	.66	.66	9.75	2.82	1.81	10.58	15.40	2.94	1.64	4.81	4.81
11	1.88	.71	.66	34.80	2.23	4.69	515.40	15.40	2.64	7.60	3.92	3.92
12	10.01	.71	.66	12.10	2.30	2.74	15.40	15.40	12.68	17.63	3.26	3.58
13	8.68	.71	.71	6.54	2.16	2.02	15.40	15.40	4.63	17.09	3.26	3.58
14	3.46	.71	.66	5.06	10.80	1.75	31.40	15.40	3.58	5.75	2.94	2.94
15	1.95	.71	.71	4.88	8.68	1.49	5.65	15.40	3.42	4.27	2.79	1.77
16	1.75	.71	.71	3.54	5.34	1.25	5.65	5.65	4.27	2.94	3.58	1.77
17	1.49	.66	.76	4.05	4.16	1.88	3.88	2.00	3.58	2.79	3.58	1.64
18	1.43	.71	2.67	3.54	5.15	2.52	2.77	10.00	9.12	2.64	4.27	1.77
19	1.75	.71	(d)	2.60	7.15	2.02	4.62	4.00	4.63	7.39	3.75	1.91
20	1.75	.66	24.00	2.90	3.62	11.00	4.62	4.00	7.81	5.75	2.64	2.19
21	1.55	.76	9.75	12.95	2.82	(d)	3.88	2.64	5.37	4.09	2.05	12.68
22	1.49	.71	6.23	5.53	2.30	.....	3.88	2.33	3.58	3.92	2.05	(c)
23	1.31	.76	5.06	4.05	2.08	.....	3.15	1.77	2.94	3.58	2.05	9.12
24	1.19	.71	15.63	3.64	1.88	.....	8.03	1.52	2.64	3.26	2.33	5.37
25	1.13	.76	(c)	2.82	1.81	.....	3.88	1.40	2.05	2.94	2.79	3.92
26	1.08	.71	(c)	2.52	2.45	.....	3.15	1.40	1.64	2.64	2.79	3.26
27	1.08	.66	(c)	2.52	2.45	.....	2.77	1.40	1.64	2.33	2.64	3.26
28	1.08	.66	(c)	2.52	2.16	.....	2.77	1.05	1.64	2.05	2.33	3.75
29	1.02	.....	(c)	2.23	2.16	.....	2.77	1.64	1.64	1.91	[e]36.56	25.20
30	.96	.....	(c)	2.30	1.81	.....	12.19	4.63	1.52	1.91	5.37	8.90
31	.91	.....	29.50	.....	1.62	.....	9.33	3.92	.....	3.26	.....	5.75

[a] Not including waste over spillway August 8–15.
[b] From record at intake dam July 9 to August 20.
[c] Exceeded capacity of weir.
[d] No record.
[e] Approximate.

Estimated monthly discharge of Starch Factory Creek near New Hartford, N. Y., for 1905.

[Drainage area, 3.40 square miles.]

Month.	Discharge in second-feet.				Run-off.		Rainfall.
	Maximum.	Minimum.	Mean.	Corrected mean.[a]	Second-feet per square mile.	Depth in inches.	Inches.
January	17.50	0.91	3.44	4.21	1.24	1.43	1.99
February	.86	.66	.71	1.48	.44	.458	.84
March (24 days)		.66	4.35	5.12	1.50	1.34	3.33
April	34.80	2.23	8.54	9.31	2.74	3.06	3.68
May	10.80	1.62	3.44	4.21	1.24	1.43	4.16
June (20 days)	11.00	.96	2.65	3.42	1.00	.744	10.00
July (23 days)	515.40	2.77	29.35	30.12	8.86	7.58	7.70
August	15.40	1.05	7.86	8.63	2.54	[b] 2.93	6.88
September	159.00	1.28	11.16	11.93	3.51	3.92	7.03
October	17.63	1.16	4.00	4.77	1.40	1.61	4.72
November	36.56	2.05	5.13	5.90	1.74	1.94	3.36
December (30 days)		1.64	5.91	6.68	1.96	2.19	3.36

[a] Including diversion to Graefenberg reservoir.
[b] This does not include waste over spillway August 8-15.

Precipitation at Savage reservoir near Utica, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.08	0.07		0.04			0.27			0.71	
2							0.96	.02			.04	0.02
3	0.49		.10		.10	0.26	.61		1.21	1.15		1.40
4	.16			0.18	.27				.87		.03	.55
5	.04			.92		.13	.69		1.33			.03
6		.28		.28	.29	.41	.06	.07	.10		.26	
7	.20			.30	.34	.06	.14	1.20	.41		.30	
8	.09		.11			.61	.10		.51		.06	
9	.03	.18	.27		.25						.39	
10		.12									.04	
11		.08		.35		.35						
12	.39	.26		.36	.05	.17	2.19	1.15	.02	1.70		.03
13	.21	.04					.31	.65	.04	.57	.03	
14						.04	.46		.02	.18		
15				.09	.86		.54	.49			.28	
16								1.10	.33			
17			.07	.06	.06	.25	.03	.42		.02	.16	
18		.10			.33	.29			1.10	.67	.10	
19	.23		.30		.22	.44	.36			.34		
20	.03		.55			.49	.49	.04		.27	.63	
21				.45		.68		.21	.57			.55
22	.18		.95	.18		1.60				.10		.36
23						.04			.24	.12		.24
24							.44					.10
25	.12		.75	.02			.26			.03	.04	
26						1.82						
27					.52	.41		.10			.09	
28						1.54				.03		
29						.05	.02	.38		.07	.61	.18
30				.26	.21		.91	.37			.25	.12
31			.33					.91				
Total	2.17	1.14	3.50	3.45	3.54	9.64	8.57	7.38	7.35	5.25	4.02	3.58

[a] Precipitation observed at 8 a. m. and credited to day of observation.

SYLVAN GLEN CREEK NEAR NEW HARTFORD, N. Y.

New Hartford or Sylvan Glen Creek is the inflowing stream tributary to reservoir No. 4 of the Utica waterworks. The stream consists of two main branches, the larger flowing in a deep-cut, wooded shale valley, the smaller draining a shallow ravine and a marshy divide. The drainage basin, which lies at an elevation of from 700 to 1,500 feet above tide, is shown on the Utica and Oriskany sheets of the United States Geological Survey topographic atlas. It comprises chiefly woodland and pasture, with some tillage, and is 1.18 square miles in extent. The flow of this stream became very small in May, 1903, and it may cease altogether at times.

The weir now used, which is located at the mouth of the stream, was erected in January, 1904, by the Consolidated Water Company, of Utica, N. Y., by whom the record is furnished. The weir has a main crest 6 feet long, with two end contractions, and a central low-water notch 2 inches deep and 2 feet long, making a total length of 8 feet. The gage is placed 6 feet upstream and is read twice daily.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905, and in the following Water-Supply Papers of the United States Geological Survey:

Description, 97, p. 216; 125, p. 37.
Discharge, daily: 97, p. 216; 125, p. 38.
Discharge, monthly: 97, p. 216; 125, p. 39.
Rating table: 97, p. 217.

Daily discharge, in second-feet, of Sylvan Glen Creek near New Hartford, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.63	0.12	0.07	3.21	0.26	0.02	0.34	0.56	0.34	0.21	2.26	0.66
2	3.91	.12	.07	1.10	.22	.06	[a]40.50	.27	.46	.18	1.16	1.06
3	1.41	.11	.07	1.10	.22	.05	2.26	.15	6.26	1.92	.96	14.89
4	1.04	.07	.07	2.82	.36	.04	3.13	.05	[a]45.00	.56	.76	3.97
5	.68	.05	.07	7.32	.38	.04	2.42	.02	3.97	.38	.56	2.67
6	.55	.05	.07	7.32	.42	.18	1.42	13.49	2.75	.27	2.75	1.92
7	1.21	.05	.05	3.31	.83	.42	.56	.56	6.26	.21	1.42	1.59
8	1.26	.05	.05	1.85	.33	.76	.46	.27	2.09	.21	1.92	1.59
9	.77	.06	.06	1.33	.59	.20	.34	.18	.86	.21	1.42	1.59
10	.68	.07	.07	1.41	.35	.10	.21	.10	.76	.15	1.16	1.42
11	.55	.07	.07	13.31	.24	.56	[b]70.00	.46	.76	.42	.96	.96
12	1.70	.07	.07	2.41	.24	.31	2.09	.56	2.42	6.26	.76	.96
13	2.74	.07	.07	1.26	.21	.16	.46	1.16	.96	5.76	.76	.96
14	.72	.07	.06	.83	3.41	.09	1.26	.38	.76	1.92	.76	.76
15	([c])	.07	.06	.94	1.70	.04	.96	3.13	.66	.96	.66	.56
16	.....	.07	.05	.72	.72	.02	.42	4.78	.96	.76	1.16	.42
17	.....	.07	.07	.55	.55	.27	.31	1.42	.56	.56	.96	.27
18	.....	.07	.26	.44	1.70	1.76	.21	.42	.75	.42	.96	.21
19	.....	.07	28.90	.38	1.26	.34	1.16	.31	.96	3.97	.86	.27
20	.....	.08	8.76	.42	.42	1.92	.27	.34	1.76	4.38	.76	.38
21	.....	.10	4.01	4.12	.33	25.14	.15	.27	1.16	2.42	.56	10.20
22	.....	.10	1.56	1.04	.27	6.00	.10	.27	.66	1.16	.42	8.24
23	.....	.10	1.33	.59	.22	2.09	.08	.21	.56	.96	.38	2.75
24	.....	.07	6.84	.42	.20	.96	.42	.21	.42	.76	.56	2.26
25	.....	.08	35.10	.36	.14	.46	.21	.15	.34	.76	.76	1.59
26	.....	.10	19.50	.33	.55	[a]40.00	.10	.10	.27	.56	.56	1.06
27	.....	.07	19.50	.29	.27	23.94	.05	.10	.21	.56	.56	.96
28	.....	.07	11.44	.26	.12	3.13	.05	.10	.21	.56	.38	.96
29	.15	.....	15.68	.29	.06	1.06	.05	.21	.21	.42	7.50	6.75
30	.15	.....	14.56	.29	.07	.56	1.42	2.09	.21	.42	1.16	2.42
31	.15	.....	6.10	.....	.05	.....	1.06	.76	.....	.96	.....	1.42

[a] Approximate. [b] Approximate. Exceeded capacity of weir. [c] No record.

Estimated monthly discharge of Sylvan Glen Creek near New Hartford, N. Y., for 1905.

[Drainage area, 1.18 square miles.]

Month.	Discharge in second-feet.			Run-off.		Rainfall.[a]
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Inches.
January (1-14, 29-31)	3.91	0.15	1.14	0.966	0.611	1.49
February	.12	.05	.076	.064	.068	.84
March	35.10	.05	5.63	4.77	5.50	3.33
April	13.31	.26	2.00	1.69	1.89	3.68
May	3.41	.05	.538	.456	.526	4.16
June	40.00	.02	3.69	3.13	3.49	10.00
July	70.00	.05	4.27	3.62	4.17	7.70
August	13.49	.10	1.05	.890	1.03	6.88
September	45.00	.21	2.78	2.36	2.63	7.03
October	6.26	.15	1.27	1.08	1.24	4.72
November	7.50	.38	1.19	1.01	1.13	3.36
December	14.89	.21	2.44	2.07	2.39	3.36

[a] Mean of Savage and Graefenberg records.

GRAEFENBERG CREEK NEAR NEW HARTFORD, N. Y.

This small catchment basin, having an area of 0.282 square mile, consists of cleared farm land, chiefly meadow and pasture, and lies between elevations 1,100 and 1,300 feet above tide, near the summit of the general plateau south of Mohawk River. The geologic strata backward from the Mohawk in this region are, successively, the Hudson River shale, Medina sandstone, and Clinton limestone. The Hudson River shale yields few permanent springs and but little ground water. The Graefenberg basin lies above the shale and a large part of its water is derived from springs, probably in the Clinton series, which are supplied from points outside the topographic basin and the yield of which has been developed by tile drainage. The measured discharge exceeds the precipitation on the basin. Sylvan Glen Creek, an adjacent drainage basin at a lower level and entirely within the Hudson River shale, sometimes becomes entirely dry in summer.

A gaging weir was erected above the inflow to Graefenberg reservoir June 7, 1903, and a standard rain gage was placed on the adjoining meadow slope, some distance from trees and structures. The weir is compound in form and has a crest length of 5 feet, with two end contractions and a central notch 2 feet long, 0.21 foot deeper. The discharge is calculated by the Francis formula. The flow of the stream is very steady. The gages are read by Richard Owen and the record is furnished by the Consolidated Water Company, of Utica, N. Y.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 213; 125, p 39.
Discharge, daily: 97, p 214.

Daily discharge, in second-feet, of Graefenberg Creek near New Hartford, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.24	0.68	2.51	1.87	0.78	0.57	0.96	1.29	0.81	0.78	1.33	1.00
2	1.92	.70	2.51	1.33	.78	.57	2.79	.91	.96	.78	1.00	2.27
3	.96	.70	2.51	1.29	.75	.57	1.19	.81	3.20	1.19	1.05	3.65
4	.84	.68	2.51	2.16	.91	.59	1.10	.75	2.99	.88	1.00	1.60
5	.72	.75	2.51	2.58	.81	.59	1.00	.72	1.60	.81	.91	1.38
6	.72	.77	2.51	2.27	.88	.68	.91	1.38	1.65	.78	1.60	1.29
7	1.24	.75	2.54	1.76	1.29	.91	.88	.96	2.10	.78	1.14	1.29
8	.81	.75	2.54	1.56	.84	.91	.81	.81	1.43	.78	1.38	1.29
9	.72	.73	2.51	1.94	.96	.62	.75	.75	1.14	.78	1.24	1.38
10	.68	.73	2.51	2.33	.78	.59	.72	.75	1.05	.78	1.10	1.29
11	.62	.72	2.51	2.99	.72	.75	.81	1.24	1.29	3.80	1.14	1.19
12	2.03	.72	2.51	1.70	.78	.68	1.00	1.70	1.76	2.16	1.10	1.19
13	.96	.72	2.51	1.33	.68	.59	1.00	1.43	1.24	1.76	1.05	1.10
14	.68	.68	2.51	1.19	1.65	.57	4.57	.96	1.05	1.19	1.10	1.10
15	.65	.70	2.51	1.24	1.24	.57	1.29	1.14	.96	1.05	1.00	1.00
16	.65	.66	2.51	1.14	1.43	.59	.96	2.33	.91	.96	1.00	1.00
17	.65	.66	2.54	1.10	.88	.62	.88	1.24	.85	.91	1.05	.91
18	.65	.68	3.20	.96	1.10	.85	.81	1.05	2.86	.89	1.05	.91
19	.75	.68	12.06	.91	1.19	.65	1.19	.91	1.14	1.24	1.10	1.00
20	.68	.68	2.99	1.05	.84	1.29	.78	.88	1.24	1.24	1.05	1.10
21	.65	.65	1.24	1.98	.78	7.45	.75	.88	1.05	1.05	.96	2.92
22	.65	.62	1.05	1.14	.75	1.60	.72	.81	1.00	1.05	.91	3.35
23	.62	.60	1.16	.96	.68	1.14	.72	.75	.96	1.05	.91	1.60
24	.64	.59	4.80	.91	.65	.91	1.10	.75	.91	.91	.89	1.38
25	.65	.62	11.73	.84	.62	.81	.81	.72	.85	.91	.96	1.29
26	.65	.62	7.16	.81	.81	7.45	.75	.72	.85	.85	.93	1.19
27	.68	.62	9.1	.81	.68	4.10	.68	.70	.85	.85	.96	1.19
28	.70	.62	5.59	.78	.65	1.76	.65	.68	.85	.85	.91	1.19
29	.68	.....	6.71	.88	.59	1.24	.72	.75	.81	.85	3.20	3.35
30	.66	.....	5.78	.81	.65	.....	4.10	1.49	.78	.85	1.19	1.38
31	.....	.....	3.06	.....	.57	.....	1.70	.96	.....	1.00	.....	1.29
Mean	.825	.681	3.82	1.42	.862	1.39	1.22	1.01	1.30	1.09	1.14	1.52

Precipitation at Graefenberg reservoir near New Hartford, N. Y., for 1905.[a]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			0.02		0.20			0.47			0.54	
2	0.02	0.04					0.60				.03	0.01
3	.36	.04			.60	0.22	.45		1.20	1.09		1.27
4	.11			.12	.19				.87		.02	.61
5	.03		.05	.86		.60	.28		.93			.02
6	T.	.07	T.	.25	.21	.41	.04	.08	.08		.23	
7	.25	T.	T.	.12	.33	.50	.03	1.07	.40		.31	
8	.11	T.				.83	.10		.26		.04	
9	.04	.06	.09		.23						.25	
10	.01	.04	.11								.05	T.
11	T.	.02		.30		.35						
12	.48			.35	.50	.10	1.60	1.20	.64	1.88		.01
13	.09	.20					.26	.56	.03	.36	.01	
14		T.				.40	.46		.01	.07	.15	
15		T.		.60	1.01		.32	.34				
16		T.						1.03	.19	.01		
17		T.	.04	.50	.50	.25	.02	.13			.10	
18	T.	.05			.26	.20			.69		.09	
19	.15	.02	.28		.17	.28	.27			.41		
20	.02		.53			.80	.11	.01		.12		
21	T.			.33		.70			.34	.06		.54
22	.10		1.00	.16		1.59				.04		.31
23	T.					.01			.07	.08		.14
24							.46					.07
25	.04		.76	.08			.31		.01	.23	.03	T.
26		T.				1.57						T.
27	T.	T.	T.		.39	.31		.05			.06	
28		T.	.02			1.23				.02		
29	T.						.01	.31		.04	.52	.15
30	T.			.21	.18		.75	.33			.26	
31			.26				.75	.80				
	1.81	.54	3.16	3.88	4.77	10.35	6.82	6.38	5.71	4.19	2.69	3.13

[a] Precipitation observed at 8 a. m. and credited to day of observation.

JOHNSTON BROOK NEAR DEERFIELD, N. Y.

Johnston Brook, a small torrential stream having a drainage area of 0.79 square mile, forms one of the tributaries of Reels Creek, which enters the Mohawk at Utica. The surface soil is heavy and impervious and is nearly all sod covered, forming pasture land. It is underlain by shale rock at a slight depth. There is very little surface run-off during the summer season and the amount of ground water supplied to the stream is small.

A gaging weir was erected near the mouth of the stream in 1903 and observations were continued until the end of May, 1905. The drainage area above the gaging weir is shown on the Utica sheet of the United States Geological Survey topographic atlas. The precipitation at Deerfield reservoir, adjacent to this drainage basin, is shown in the accompanying table.

Information concerning this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 212; 125, pp 41–42.
Discharge, daily: 97, p 212; 125, p 43.
Discharge, monthly: 97, p 212; 125, p 44.

Daily discharge, in second-feet, of Johnston Brook near Deerfield, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	1.05	0.13	0.13	1.41	0.64	17	0.13	0.13	0.30	0.42	.....
2	2.12	.13	.13	2.25	.52	18	.13	.13	.....	.34	.....
3	.92	.13	.13	2.44	.52	19	.24	.13	.....	.30	.....
4	.27	.13	.13	3.85	.83	20	.21	.13	4.10	1.20	.....
5	.18	.13	.13	4.34	.57	21	.18	.13	1.75	.....	.52
6	.18	.13	.13	4.70	.92	22	.....	.13	1.20	1.51	.42
7	.57	.13	.13	2.31	1.99	23	.....	.13	.78	.82	.37
8	.57	.13	.15	2.51	.92	24	.....	.13	2.25	.52	.30
9	.30	.13	.16	2.12	1.51	25	.....	.13	.....	.47	.27
10	.18	.13	.16	3.38	.82	26	.....	.13	5.07	.37	.24
11	.18	.13	.19	.....	.57	27	.....	.13	6.26	.30	.37
12	1.00	.13	.19	2.77	.64	28	.....	.13	3.07	.30	.27
13	.57	.13	.19	.82	.52	29	.13	.....	3.38	1.15	.24
14	.33	.13	.20	.82	.....	30	.13	.....	2.25	.74	.27
15	.18	.13	.20	1.15	.....	31	.13	.....	5.07	.....	.20
16	.13	.13	.15	.57	.....						

Estimated monthly discharge of Johnston Brook near Deerfield, N. Y., for 1905.

[Drainage area, 0.79 square mile.]

Month	Discharge in second-feet.			Run-off.		Rainfall.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	Inches.
January (24 days)	2.12	0.13	0.417	0.528	0.471	1.93
February	.13	.13	.130	.164	.171	1.34
March (28 days)	6.26	.13	1.36	1.72	1.79	2.26
April (28 days)	4.70	.30	1.57	1.99	2.07	3.69
May (24 days)	1.99	.20	.601	.761	.679	3.48

Precipitation at Deerfield reservoir, near Deerfield, N. Y., for 1905.[a]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.[b]	Aug.	Sept.	Oct.	Nov.	Dec.
1	([c])				T.			0.08			0.75	
2		0.08		1.18	0.09	0.21					0.01	0.20
3			0.02		.18				1.44	0.83		2.22
4	[d] 0.83			.33	.04	.11			.78		.10	.41
5					.24	.98			1.52		.03	.02
6					.35	.06		.52	T.		.32	
7		.18				.54		.98	.40		.25	
8	.18				.20				.64		.11	
9		.23			.01						.27	
10				.45		.41					.06	
11	.35	.31		.35	.08	.17						T.
12		.25			.02	T.		.64	.71	1.46		.10
13		.12						.82	.04	.71	T.	.02
14				.25	([e])					.06	.06	T.
15								.52			T.	
16								.67	.21	.01	.07	
17		.12				.19		.06			.11	
18						.79		T.	1.11		.10	
19	.23		.42			.50				1.05	T.	.01
20			.44	.62	[d] 1.70	.23				.18		
21	.12					1.32		.13	.17	.14		.52
22	([f])		.65			.02				.19		.32
23										.06		.14
24			.41						.17	.02		.02
25	[d] .22											.01
26			.17		.41							T.
27								.06				
28		.05								.02		
29				.44	.16			.19		.03	.63	.06
30				.07				.15			.18	.24
31			.15					1.07		T.		T.
	.88	1.34	2.26	3.69	1.78	5.53		5.89	7.19	4.76	3.05	4.29
	1.93				3.48							

[a] Rainfall is credited to day on which it fell or day preceding measurement.
[b] No record.
[c] No record January 1-7, inclusive.
[d] Mean of Savage and Graefenberg reservoirs used.
[e] No record May 14-20, inclusive.
[f] No record January 22-29, inclusive.

WEST CANADA CREEK AT TWIN ROCK BRIDGE, NEW YORK.

West Canada Creek rises in West Canada Lakes, in southwest-central Hamilton County, and flows southwestward, then southeastward into the Mohawk at Herkimer, N. Y. The drainage area is shown on the Utica, Little Falls, Remsen, Wilmurt, Old Forge, and Canada Lakes sheets of the United States Geological Survey topographic atlas. There are about fifty small lakes and a few undrained ponds in the watershed of the stream, most of them situated near the headwaters and above the gaging station, the largest single water surface being Honnedaga Lake, 1.4 square miles in extent. There is also a small amount of controllable storage in reservoirs formed by three dams. Swamps and marshes are numerous in the region of the headwaters, usually adjoining lakes and tributaries, and having an extent of one-half square mile or less each. Much of the region above the gaging station is timber covered, and there are extensive sand areas in the central and upper drainage basins. The soil of the upper watershed is underlain by granitic gneiss, usually at or near

the surface, except in alluvial valleys. From a point just above Twin Rock Bridge downstream beyond Trenton Falls the underlying geologic formation is Trenton limestone.[a]

Compacted snow accumulates in the woodlands in winter, often to a depth of 3 or 4 feet, representing an inch of water for each 5 or 6 inches of snow. This melts slowly, feeding the stream in March and April, so that these months may show a run-off greatly exceeding the precipitation.

A current-meter gaging station was established September 7, 1900, at Twin Rock Bridge, by R. E. Horton. The drainage area of the creek at this point is 364 square miles; above Trenton Falls, 375 square miles.

The bed of the stream is gravel and cobble. The bridge is 167.5 feet long between abutments, and consists of two spans. The entire flow passes beneath at all stages. In winter the stream becomes completely ice covered, requiring special discharge measurements.

A gage board is attached to the upstream side of the right-hand abutment, the coping of the abutment over the gage being used as a bench mark. The gage is read twice each day by George Rood, and the record is furnished by the Utica Gas and Electric Company. Elevation 15.50 feet above gage datum.

At the Trenton Falls dam, tests by weir to determine the discharging capacity of the turbines, which are of a special Swiss design, have been made by the power company, and observations taken at this dam during the freshet season have been used to complete and extend the gaging record at Twin Rock Bridge.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905, and in the following Water-Supply Papers of the United States Geological Survey:

Description: 47, p 49; 65, pp 153-154; 82, p 87; 97, pp 196-197; 125, pp 46-47.
Discharge: 47, p 39; 65, p 154; 82, p 88; 97, p 197; 125, p 48.
Discharge, daily: 97, pp 200-203; 125, p 49.
Discharge, flood: 65, p 155.
Discharge, monthly: 97, pp 204-205; 125, p 50.
Gage heights: 47, p 50; 65, p 154; 82, p 88; 97, p 198; 125, p 48.
Rating table: 97, p 199.

Discharge measurements of West Canada Creek at Twin Rock Bridge, New York, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 27	Beebe and Weeks	168	1,232	4.06	6.18	5,004
August 27 [b]	Horton and Weeks	158	290	.76	.58	220
August 28 [b]	Weeks and Wood	160	312	.73	.78	229
August 30 [b]	H. H. Halsey	162	361	.85	1.00	307
October 11 [b]	D. L. Mott	162	375	.96	1.02	361
November 15 [c]	do	168	644	1.12	2.60	719
November 17 [c]	do	168	580	1.41	2.10	818

[a] For geologic description of Trenton Falls, see Prosser, C. S., and Cummings, E. R., Rept. New York State Museum, 1895, pp. 619-628.
[b] Log jam below bridge; also obstruction on pier.
[c] Log jam below bridge.

Daily discharge, in second-feet, of West Canada Creek at Twin Rock Bridge, New York, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	772	220	206	7,522	3,655	675	2,479	1,010	741	395	1,363	3,950
2	674	271	206	3,995	2,768	602	2,743	810	326	494	1,810	3,350
3	458	381	206	[a]4,005	3,655	602	8,100	920	2,768	395	2,382	5,000
4	492	424	206	4,016	1,995	581	4,952	901	8,120	358	1,438	4,300
5	509	424	192	7,714	2,624	602	1,995	423	8,700	358	755	2,850
6	407	390	199	6,973	1,475	626	1,724	650	3,710	414	1,325	2,020
7	390	356	322	4,813	2,768	1,010	1,766	581	2,479	452	2,768	1,810
8	424	322	192	2,607	3,292	1,288	727	559	1,252	376	2,089	1,236
9	526	356	220	2,607	1,640	1,010	810	591	1,040	358	1,902	750
10	526	356	254	2,659	1,902	782	727	473	1,075	326	755	1,066
11	598	356	254	2,871	1,948	755	1,288	342	638	311	838	636
12	598	356	560	6,973	1,040	1,010	935	473	581	1,180	755	970
13	598	288	254	6,470	950	950	626	755	342	1,948	1,252	712
14	750	288	237	4,319	838	494	591	473	326	1,557	920	750
15	750	185	254	4,198	980	537	581	515	376	700	1,075	674
16	636	185	150	4,441	1,363	581	650	1,363	342	626	1,075	441
17	598	322	150	2,154	1,363	1,363	713	1,252	376	675	782	509
18	560	206	390	2,007	1,557	2,915	1,040	1,198	1,995	700	700	475
19	543	220	390	1,605	1,145	2,721	727	1,145	3,111	2,624	727	526
20	526	220	543	1,521	1,145	2,817	1,110	281	2,042	2,915	755	526
21	475	220	712	6,190	1,145	3,424	1,127	295	1,252	1,995	755	458
22	373	220	1,210	8,888	1,010	4,150	882	281	810	1,456	650	970
23	356	220	750	6,612	838	2,672	395	268	920	1,252	537	1,018
24	475	254	712	4,750	727	1,252	838	240	1,010	1,162	473	838
25	458	271	882	4,016	782	1,040	838	204	311	995	626	560
26	424	509	1,018	4,844	782	2,089	755	184	311	950	950	579
27	475	192	1,262	4,970	980	2,721	865	247	494	865	700	579
28	492	192	1,694	4,938	755	1,438	950	288	494	687	581	579
29	526	.....	1,900	5,580	882	1,216	865	240	311	727	1,401	617
30	492	.....	3,620	6,330	755	1,252	1,401	247	494	473	3,710	1,262
31	390	.....	7,358	.....	727	.....	1,438	1,025	.....	980	.....	1,288

[a] Interpolated.

NOTE.—River frozen entirely across, January 1 to February 20. From February 21 to March 31 there was open water near the banks and also below the gage. Average thickness of ice: January 1-31, 0.6 feet; February 1-21, 1.2 feet; February 22 to March 8, 0.8 foot; March 9-30, 0.5 foot. The discharge is computed from special rating tables, ice conditions and backwater due to log jams being taken into account.

Estimated monthly discharge of West Canada Creek at Twin Rock Bridge, New York, for 1905.

[Drainage area, 364 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	772	356	525	1.44	1.66
February	509	185	299	.821	.855
March	7,358	150	855	2.35	2.71
April	8,888	1,521	4,686	12.87	14.36
May	3,655	727	1,532	4.21	4.85
June	4,150	494	1,442	3.96	4.42
July	8,100	395	1,440	3.96	4.56
August	1,363	184	588	1.62	1.87
September	8,700	311	1,558	4.28	4.78
October	2,915	311	926	2.54	2.93
November	3,710	473	1,195	3.28	3.66
December	5,000	441	1,332	3.66	4.22
The year	8,888	150	1,365	3.75	50.87

WEST CANADA CREEK AT KAST BRIDGE, NEW YORK.

This station was established May 15, 1905. It is located on the bridge opposite the railway station at Kast Bridge, New York, about 4 miles along the stream above the mouth of the creek at Herkimer. The drainage area at this point is 574 square miles, or 58 per cent greater than at Twin Rock Bridge.

This portion of the basin is underlain by Hudson River and Trenton shales. The topography is moderately rolling. The soil is ordinarily rather impervious and usually under culture. The precipitation and snow storage are considerably less than in the upper part of the drainage area.

Discharge measurements are made from the downstream side of the bridge to which the gage tape is attached. The initial point for soundings is the top face of the left abutment, downstream side. A tape and reel gage is used.

A gage chain is fastened to the upstream hand rail of the bridge 100 feet from the left abutment. The length of the chain from the end of the weight to the marker is 49.80 feet. During 1905 the gage was read twice each day by Lloyd Kast. Gage readings at this station are paid for by the State of New York. The bench mark is on the downstream corner, nearest the water, on the plate of the bridge on the left-hand abutment, downstream side; elevation, 43.53 feet above the gage datum.

Discharge measurements of West Canada Creek at Kast Bridge, New York, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	Beebe and Weeks	196	922	4.81	30.68	4,438
May 9	Beebe and Mills	196	551	3.28	29.57	1,819
May 15	Swancott and Weeks	190	511	2.60	29.39	1,332
July 8	Beebe and Mills	196	513	2.73	29.44	1,403
August 27	C. A. Cockroft	168	264	1.32	28.26	350
August 31	Cockroft and Halsey	178	388	1.77	28.78	688
October 7	D. L. Mott	178	368	1.82	28.67	594
November 14	do	195	583	3.02	29.74	1,763

Daily gage height, in feet, of West Canada Creek at East Bridge, New York, for 1905.

Day	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	28.83	29.23	29.27	29.18	28.55	30.32	30.3
2	.....	28.77	32.1	29.05	28.78	28.6	30.62	29.88
3	.....	28.75	32.7	28.9	31.25	29.0	30.12	33.55
4	.....	28.77	31.45	28.7	34.7	29.1	30.02	32.1
5	.....	29.67	30.4	28.57	34.48	28.88	29.98	31.0
6	.....	29.13	29.87	28.8	31.6	28.65	30.35	30.45
7	.....	29.37	29.43	29.4	30.8	28.6	31.08	30.0
8	.....	29.97	28.93	29.0	30.2	28.6	30.82	29.9
9	.....	29.87	29.03	28.67	29.62	28.58	30.4	29.58
10	.....	29.37	29.03	28.6	29.55	28.55	29.92	29.5
11	.....	29.23	28.73	28.55	29.18	28.45	29.75	29.0
12	.....	29.77	28.77	28.77	29.38	29.55	29.62	29.08
13	.....	29.43	28.85	29.17	29.28	30.48	29.58	29.3
14	.....	29.5	29.23	28.83	29.18	30.2	29.78	29.08
15	29.5	29.07	29.43	28.83	28.92	29.72	29.58	28.6
16	29.23	29.03	29.05	30.17	28.88	29.45	29.45	28.6
17	29.43	28.97	28.9	29.8	28.75	29.22	29.45	28.6
18	29.17	30.37	29.17	29.13	30.72	29.28	29.32	28.78
19	29.57	30.15	29.13	28.9	31.25	30.88	29.35	28.82
20	29.37	30.53	29.75	28.63	30.4	31.0	29.22	28.92
21	29.1	30.2	29.3	28.55	30.52	30.6	28.68	29.72
22	29.27	31.25	28.9	28.55	29.8	30.2	28.9	30.68
23	29.03	30.45	28.8	28.33	29.58	29.82	28.92	30.38
24	29.87	29.73	28.77	28.3	29.22	29.58	29.12	29.88
25	29.93	29.13	28.73	28.23	29.0	29.52	29.42	29.4
26	28.77	31.35	28.8	28.03	28.88	29.4	29.42	29.3
27	29.05	30.83	28.63	28.23	28.78	29.2	29.48	29.18
28	29.15	30.55	28.47	28.07	28.78	29.05	29.3	29.08
29	28.97	29.7	28.45	28.32	28.62	28.95	31.48	29.98
30	29.0	29.57	28.55	28.42	28.68	28.9	31.48	30.25
31	28.97	.....	29.73	28.92	.....	28.9	.....	29.95

EAST CANADA CREEK AT DOLGEVILLE, N. Y.

This creek rises in Hamilton County, flows southward between Herkimer and Fulton counties, and joins the Mohawk at East Creek. A portion of the stream and drainage basin is shown on the Little Falls and Lassellville sheets of the United States Geological Survey topographic atlas.

Observations are taken at High Falls, near Dolgeville, about 7 miles from the outlet of the stream. The gaging station is located at the dam of the Herkimer County Light and Power Company. The dam is of rubble masonry, 19 feet high, and has a flat crest 6 feet wide and 190.25 feet long between abutments. The elevation of the upstream edge of the crest is 1 foot below that of the lip. The impounded water is conducted to the power house, 500 feet below the dam, through a wrought-iron flume 10 feet in diameter.

Readings of the depth on the crest are taken from a vertical gage board attached to the bulkhead, 6 feet upstream, twice each day by Willard Hayward. The mean of the readings is used in computing the discharge. A record is also kept of the run of the water wheels and the elevation of water in the tailrace. The record since January 1, 1903, has been computed from a discharge curve based on the United States Geological Survey experiments on a full-sized model of the dams, made at Cornell University. The flow through the turbines for this period has also been computed from current-meter measurements, made in the tailrace of the electric-power plant instead of from the manufacturers' rating tables for the water wheels, as formerly. The turbines are of a special Victor cylinder-

gate type. The two main wheels are each 36 inches in diameter, and their speed is controlled by Lombard governors.

Spruce Creek, the principal tributary of East Canada Creek, enters 1 mile above Dolgeville, and drains an area of 50 square miles. Water is diverted from this creek and from Beaver Creek, one of its tributaries, at Diamond Hill, and is carried to Little Falls through a vitrified conduit 9 miles long. The water supply of Dolgeville is taken from Cold Brook, a tributary of East Canada Creek. No allowance for diversion of water supply has been made in computing the run-off for East Canada Creek.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 35, p 52; 47, pp 55-57; 65, pp 158-159; 82, p 89; 97, p 195; 125, pp 50-51.
Discharge: WS 47, pp 39, 56-57; 65, p 159; 82, p 89.
Discharge, daily: WS 35, p 52; 47, pp 57-58; 65, p 161; 82, p 90; 125, pp 51-52.
Discharge, flood: WS 65, p 160.
Discharge, low-water: WS 65, p 161.
Discharge, monthly: Ann 21, iv, p 68; 22, iv, p 96; WS 35, p 24; 65, p 161; 82, p 91; 97, p 196; 125, p 53.
Gage heights: WS 97, p 195.
Hydrographs: Ann 21, iv, p 68; 22, iv, p 97.
Rainfall data: WS 97, p 196.
Water powers: WS 65, p 160.

Daily discharge, in second-feet, of East Canada Creek at Dolgeville, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	137	136	(a)	1,479	291	408	465	4,065	(a)	1,009	1,626
2	(a)	129	137	(a)	1,160	223	2,321	327	4,070	213	1,213	3,300
3	596	129	127	3,864	916	281	3,299	260	2,305	347	972	5,572
4	448	110	139	(a)	1,130	213	1,920	200	4,422	270	876	(a)
5	286	84	101	4,379	883	228	1,229	212	3,108	287	619	1,982
6	324	131	129	4,097	859	578	818	188	1,766	224	1,055	1,348
7	410	b 117	89	2,768	965	1,011	617	188	968	254	1,523	1,089
8	304	117	94	1,894	874	1,069	493	168	730	(a)	1,124	821
9	401	112	113	(a)	798	684	423	134	617	192	1,117	668
10	399	112	123	1,514	761	465	285	117	(a)	166	685	455
11	277	100	123	2,713	1,655	(a)	250	155	376	181	616	643
12	327	42	95	3,342	1,641	788	269	172	236	878	(a)	464
13	411	115	123	3,047	1,582	629	226	200	654	1,001	537	401
14	404	120	121	2,750	1,569	478	314	258	519	653	594	376
15	386	142	150	2,295	1,631	400	276	427	394	559	443	136
16	538	125	149	1,652	1,696	319	213	716	900	632	480	150
17	612	131	146	1,264	1,565	455	227	464	1,028	391	455	(a)
18	386	90	148	1,177	1,303	(a)	289	306	1,517	850	409	196
19	348	90	(a)	881	661	390	382	281	1,295	1,287	339	313
20	267	b 121	738	882	519	335	400	208	1,152	1,292	331	335
21	249	126	777	1,974	(a)	1,011	281	(a)	1,079	(a)	315	629
22	229	117	739	2,146	488	2,299	218	179	748	896	329	984
23	172	116	700	(a)	373	1,340	281	138	632	641	311	858
24	169	124	600	1,902	292	(a)	336	122	354	589	285	625
25	175	124	779	1,610	320	1,016	250	115	344	447	281	540
26	132	125	1,166	1,606	268	2,003	191	108	294	458	292	402
27	136	123	1,470	1,548	505	1,717	185	(a)	283	395	422	317
28	119	135	2,062	1,610	500	2,087	178	73	249	376	320	322
29	63	.....	2,546	1,659	363	1,178	183	129	219	276	1,195	554
30	126	.....	4,045	1,843	317	1,040	(a)	231	223	274	2,128	623
31	202	.....	5,004	.....	336	.....	617	138	.....	344	.....	490

a Record not available.
b February 7-20, inclusive, dam obstructed by ice; record probably deficient.

Estimated monthly discharge of East Canada Creek at Dolgeville, N. Y., for 1905.

[Drainage area, 256 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.[a]	Mean.	Second-feet per square mile.	Depth in inches.
January (29 days)	612	63	307	1.20	1.29
February	142	42	116	.453	.472
March (30 days)	5,004	89	762	2.98	3.32
April (25 days)	4,379	881	2,177	8.50	7.90
May (30 days)	1,696	317	914	3.57	3.98
June (27 days)	2,299	213	834	3.26	3.27
July (30 days)	3,299	178	579	2.26	2.52
August (29 days)	716	73	230	.898	.968
September (29 days)	4,422	219	1,191	4.65	5.02
October (28 days)	1,292	166	513	2.00	2.08
November (29 days)	2,128	281	699	2.73	2.94
December (29 days)	5,572	136	904	3.53	3.81

[a] Minimum controlled by pondage.

SCHOHARIE CREEK AT PRATTSVILLE, N. Y.

Schoharie Creek above Prattsville drains a rugged, mountainous area, almost entirely wooded. The watershed, 243 square miles in extent, lies wholly within Greene County. Rocks of the Catskill formation, chiefly sandstones and conglomerates, lie at or near the surface over most of the area. The basin is surrounded by nearly continuous mountain ranges, and intervening ridges divide the main stream from its principal tributaries, Batavia Kill, East Kill, and West Kill.

A gaging station was established November 7, 1902, at the highway bridge in the village of Prattsville, by C. C. Covert.

The bridge has a single span of 185 feet. In extreme low water the current underneath the bridge is sluggish, and meter measurements are made by fording the stream a short distance below the bridge.

A standard chain gage is attached to the steel floor beams of the bridge on the upstream side; length of chain, 25.74 feet. Gage readings are taken each morning and evening by James Brennan. The gage datum is referred to the United States Geological Survey bench mark—a circle marked on a bowlder at the right-hand end of the bridge on the downstream side; elevation, 1,151.00 feet. Elevation of gage zero, 1,130.03 feet.

The great freshet of October 9–11, 1903, apparently changed the stream bed and cross section in the vicinity of the gage. Measurements made during 1904 and 1905 have been applied toward the construction of a new rating curve.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, pp 95–96; 97, pp 191–192; 125, p 54.
Discharge: 82, p 96; 97, p 192; 125, p 54.
Discharge, daily: 25, pp 57–58.
Discharge, monthly: 125, p 59.
Gage heights: 82, p 96; 97, pp 193–194; 125, p 55.
Rating table: 125, p 56.

Discharge measurements of Schoharie Creek at Prattsville, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 11 [a]	C. C. Covert	32	20.5	1.40	4.20	28.6
August 11 [a]	do	32	21.2	1.39	4.20	29.4

[a] Wading below bridge.

Daily gage height, in feet, of Schoharie Creek at Prattsville, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	5.07	4.91	6.85	4.79	4.31	4.21	4.34	4.58	4.42	4.65	5.25
2	5.4	5.07	4.91	6.2	4.64	4.31	4.31	4.5	4.5	4.4	4.6	5.6
3	5.5	5.07	4.96	6.0	4.59	4.28	4.31	4.42	5.18	4.6	4.52	7.6
4	5.4	5.07	4.96	5.75	4.59	4.31	4.24	4.34	7.3	4.58	4.5	6.78
5	6.2	5.07	4.96	5.9	4.54	4.25	4.22	4.3	6.0	4.5	4.5	5.82
6	6.2	5.07	4.96	6.27	4.49	4.35	4.22	4.29	5.32	4.48	4.5	5.58
7	8.25	5.07	4.96	6.2	4.59	4.41	4.2	4.23	5.02	4.45	4.65	5.42
8	7.08	5.07	4.96	5.93	4.49	4.43	4.17	4.23	4.88	4.42	4.7	5.35
9	6.35	5.07	5.44	5.65	4.46	4.33	4.12	4.21	4.72	4.38	4.65	5.3
10	5.95	5.07	5.61	5.55	4.49	4.28	4.07	4.21	4.65	4.38	4.65	5.2
11	5.6	5.07	5.76	6.23	4.42	4.31	4.17	4.25	4.6	4.35	4.6	5.2
12	6.5	5.07	5.46	6.5	4.49	4.35	4.17	4.52	5.1	7.35	4.6	5.1
13	6.4	5.07	5.16	6.0	4.49	4.58	4.22	4.52	5.5	5.65	4.6	5.25
14	6.25	5.07	5.01	5.75	4.52	4.48	4.22	4.4	5.05	5.2	4.5	5.9
15	5.47	5.07	4.96	5.65	4.56	4.35	4.22	4.4	4.9	5.05	5.1	4.8
16	5.37	5.07	4.96	5.6	4.54	4.31	4.2	4.72	4.75	4.98	5.0	4.9
17	5.27	5.07	4.91	5.45	4.56	4.31	4.17	4.75	4.68	4.72	4.5	4.78
18	5.22	5.07	6.34	5.33	4.49	4.31	4.12	4.62	4.75	4.8	4.5	4.8
19	5.19	5.07	8.24	5.23	4.54	4.28	4.14	4.52	4.92	4.92	4.5	4.82
20	5.19	5.04	7.61	5.15	4.46	4.35	4.17	4.42	5.02	5.2	4.48	4.88
21	5.07	4.98	6.41	5.2	4.46	4.41	4.17	4.38	5.05	5.08	4.45	5.2
22	5.02	4.96	5.74	5.23	4.44	4.45	4.12	4.28	4.88	5.08	4.6	4.72
23	5.07	4.96	5.58	5.07	4.42	4.45	4.12	4.28	4.72	5.02	4.45	5.22
24	5.07	4.96	6.35	5.03	4.36	4.41	4.14	4.3	4.7	4.95	4.45	5.2
25	5.07	4.96	9.1	4.9	4.34	4.31	4.12	4.3	4.65	4.92	4.5	5.08
26	5.07	4.96	6.85	4.85	4.34	4.31	4.12	4.3	4.6	4.85	4.5	5.02
27	5.07	4.91	7.9	4.82	4.39	4.31	4.1	4.3	4.5	4.8	4.5	5.0
28	5.07	4.91	7.27	4.79	4.32	4.28	4.1	4.28	4.5	4.8	4.45	4.95
29	5.07	.....	7.7	4.82	4.26	4.25	4.12	4.32	4.5	4.75	4.75	5.35
30	5.07	.....	8.15	4.82	4.26	4.21	4.17	4.42	4.45	4.75	5.58	5.3
31	5.07	.....	7.7	.....	4.26	.....	4.27	4.9	.....	4.7	.....	5.08

NOTE.—River frozen entirely across as far as the rifts from January 23 to March 18, except for narrow channel of open water March 10-18. During the frozen period gage heights are to the surface of the water in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 23	5.1	5.2	0.2
January 31	5.1	5.2	.5
February 10	5.1	5.2	1.0
February 15	5.1	5.15	1.2
March 3	5.0	5.1	2.0

Station rating table for Schoharie Creek at Prattsville, N. Y., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.10	18	5.20	405	6.30	1,270	7.40	2,680
4.20	28	5.30	465	6.40	1,370	7.50	2,830
4.30	42	5.40	525	6.50	1,470	7.60	2,990
4.40	61	5.50	585	6.60	1,600	7.70	3,150
4.50	85	5.60	663	6.70	1,720	7.80	3,300
4.60	125	5.70	741	6.80	1,850	7.90	3,460
4.70	165	5.80	819	6.90	1,970	8.00	3,620
4.80	205	5.90	897	7.00	2,100	8.10	3,790
4.90	245	6.00	975	7.10	2,260	8.20	3,960
5.00	285	6.10	1,070	7.20	2,390	8.30	4,130
5.10	345	6.20	1,170	7.30	2,540		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904 and 1905. It is well defined between gage heights 4.1 feet and 8 feet. The table has been extended beyond these limits. Above 4.4 feet the table is the same as for 1904.

Estimated monthly discharge of Schoharie Creek at Prattsville, N. Y., for 1905.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches
January (1-22)	4,045	297	960	4.00	3.27
March (18-31)	5,610	647	2,580	10.75	5.60
April	1,910	201	693	2.89	3.22
May	201	36	84.2	.351	.405
June	117	29	51.7	.215	.240
July	44	15	26.1	.109	.126
August	245	29	69.3	.289	.333
September	2,540	73	321	1.34	1.50
October	2,610	52	285	1.19	1.37
November	647	73	138	.575	.642
December	2,990	173	534	2.22	2.56

Ice conditions January 23 to March 17: No estimate.

CATSKILL CREEK AT SOUTH CAIRO, N. Y.

The basin of this stream receives the run-off from the north slope of the Catskill Range and lies, for the most part, in the timbered highlands of Greene County. The slopes are precipitous, there are no lakes, and the amount of artificial storage is small. The underlying rock formation is chiefly Devonian shale. The topography of the area is shown on the Durham, Coxsackie, and Catskill sheets of the United States Geological Survey topographic atlas. The stream flows over a rock bed through much of its course and enters tide water of Hudson River at Catskill.

The gaging station was established July 4, 1901, and is located at the highway bridge in village of South Cairo.

The stream channel is rock, covered in some places with earth. The bridge has a single span of 194.5 feet between abutments.

The stage of the stream is observed each morning and night from a standard chain gage which is attached to the bridge and the elevation of which is referred to a circle near the outer corner on the upstream side of the bridge seat on the right-hand abutment. The elevation of the bench mark is 21.29 feet above gage datum.

The erection of a dam a short distance below the gage for purposes of boating necessitated withholding a portion of the record for 1904. This dam was removed in the spring of 1905, and the discharge for 1905 has been calculated from the rating table as formerly used.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 61; 97, pp 178-179; 82, pp 109-110; 125, p 60.
Discharge: 65, p 62; 82, p 110; 97, pp 179-180; 125, p 60.
Discharge, daily: 97, pp 186-188; 125, p 62.
Discharge, monthly: 97, p 189; 125, p 63.
Discharge, winter: 65, p 63.
Gage heights: 65, p 62; 82, pp 110, 111; 97, pp 181-183; 125, p 61.
Rating tables: 97, pp 184-185; 125, p 62.
Water powers: 65, p 62.

Discharge measurements of Catskill Creek at South Cairo, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 10 [a]	C. C. Covert	23	16	0.52	2.11	8.5
August 10 [a]	do	39	36	.28	2.12	9.9

[a] Wading below bridge.

Daily gage height, in feet, of Catskill Creek at South Cairo, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.63	3.05	5.92	2.92	2.16	2.34	1.95	2.55	2.45	2.7	3.05
2	3.85	3.58	3.02	5.27	2.84	2.16	2.27	2.05	2.48	2.4	2.7	2.82
3	4.4	3.48	2.97	4.67	2.86	2.13	2.24	2.08	2.75	2.6	2.65	4.3
4	5.2	3.38	2.97	4.87	2.86	2.05	2.19	2.1	6.95	2.9	2.65	6.7
5	6.3	3.33	2.97	5.27	2.76	2.1	2.14	2.1	4.45	2.8	2.6	3.95
6	7.5	3.28	2.97	5.97	2.69	2.25	2.14	2.1	3.8	2.62	2.65	3.72
7	7.0	3.23	2.97	5.12	2.64	2.25	2.14	2.05	3.5	2.5	2.6	3.6
8	6.5	3.32	2.97	4.67	2.65	2.35	2.14	2.05	3.25	2.5	2.75	3.48
9	5.18	3.3	2.95	4.37	2.56	2.35	2.04	2.1	2.85	2.4	2.68	3.48
10	4.5	3.2	3.27	4.42	2.56	2.33	2.04	2.1	2.9	2.4	2.62	3.4
11	4.22	3.26	3.57	5.02	2.48	2.3	2.04	2.1	2.9	2.45	2.6	3.2
12	4.6	3.26	3.57	5.12	2.46	2.25	2.04	2.22	3.7	4.8	2.6	3.1
13	4.5	3.2	3.57	4.69	2.44	2.25	2.04	2.2	3.35	4.0	2.6	3.17
14	4.4	3.36	3.57	4.42	2.4	2.26	2.04	2.32	3.1	3.55	2.5	3.05
15	5.6	3.36	3.57	4.32	2.41	2.22	2.04	2.4	3.05	3.28	2.53	3.05
16	5.65	3.38	3.47	4.15	2.44	2.14	2.04	2.55	2.85	3.1	2.53	3.05
17	5.55	3.36	3.49	3.91	2.55	2.09	1.99	3.0	2.9	3.02	2.52	2.85
18	4.9	3.2	3.87	3.81	2.51	2.04	1.89	2.78	2.9	2.92	2.5	2.82
19	4.6	3.23	8.42	3.71	2.45	2.12	1.89	2.5	3.3	3.5	2.5	2.85
20	3.8	3.18	6.21	3.66	2.45	2.14	1.94	2.4	3.3	3.55	2.5	2.8
21	3.75	3.13	5.17	3.66	2.44	2.18	1.94	2.3	3.2	3.5	2.49	3.82
22	3.8	3.09	4.67	3.56	2.35	2.34	1.94	2.28	3.4	3.35	2.48	3.95
23	3.8	3.1	4.17	3.46	2.35	2.9	1.84	2.25	3.15	3.19	2.48	3.94
24	3.9	3.09	4.42	3.34	2.3	2.64	1.89	2.21	3.0	3.19	2.4	3.76
25	3.95	3.08	9.32	3.27	2.23	2.44	1.92	2.2	2.88	3.05	2.3	3.45
26	4.0	3.08	8.32	3.26	2.18	2.39	1.89	2.2	2.68	2.95	2.3	3.35
27	4.4	3.08	8.82	3.26	2.18	2.54	1.88	2.2	2.6	2.78	2.3	3.14
28	4.4	3.08	7.49	3.21	2.15	2.45	1.85	2.18	2.6	2.78	2.4	3.0
29	4.0	.....	8.37	3.16	2.17	2.44	1.85	2.18	2.5	2.78	2.55	3.58
30	3.9	.....	7.97	3.06	2.19	2.44	1.94	2.2	2.46	2.78	3.08	3.7
31	3.8	.....	6.79	.....	2.16	.....	2.09	2.35	.....	2.75	.....	3.28

NOTE.—Creek frozen entirely across from January 20, approximately, to March 4, except for narrow channel under gage. Open channels on each side appeared March 4 and lasted till ice went out March 19. During the frozen period the gage was read to the surface of the water. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 4	3.4	3.7	1.1
February 11	3.25	3.8	1.3
February 18	3.2	3.35	1.3
February 25	3.1	3.4	1.1
March 4	3.0	3.2	1.0

Station rating table for Catskill Creek at South Cairo, N. Y., from July 4, 1901, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	9	3.20	104	4.50	546	6.60	2,106
1.90	10	3.30	120	4.60	602	6.80	2,328
2.00	12	3.40	136	4.70	657	7.00	2,550
2.10	14	3.50	152	4.80	712	7.20	2,822
2.20	16	3.60	182	4.90	768	7.40	3,094
2.30	20	3 70	213	5.00	824	7.60	3,406
2.40	24	3.80	243	5.20	946	7.80	3,758
2.50	28	3.90	274	5.40	1,067	8.00	4,110
2.60	37	4.00	304	5.60	1,206	8.20	4,562
2.70	45	4.10	352	5.80	1,363	8.40	5,014
2.80	55	4.20	401	6.00	1,520	8.60	5,498
2.90	63	4.30	449	6.20	1,710	8.80	6,014
3.00	72	4.40	498	6.40	1,900	9.00	6,530
3.10	88						

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1905. It is well defined between gage heights 2.5 feet and 7 feet. The table has been extended beyond these limits, being based on one measurement at 8.65 feet.

Estimated monthly discharge of Catskill Creek at South Cairo, N. Y., for 1905.

[Drainage area, 263 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 1–19	3,250	243	1,057	4.02	2.84
March 19–31	7,567	386	3,252	12.36	5.98
April	1,497	82	493	1.87	2.09
May	65	15	30.7	.117	.135
June	63	13	21.1	.080	.089
July	22	9	12.7	.048	.055
August	72	11	20.2	.077	.089
September	2,494	26	180	.684	.763
October	712	24	100	.380	.438
November	85	20	34.7	.132	.147
December	2,217	55	216	.821	.946

NOTE.—No estimates during frozen period.

ESOPUS CREEK AT KINGSTON, N. Y.

Esopus Creek has its source in northwestern Ulster County and enters Hudson River near Saugerties. Between Olivebridge and Kingston it passes successively over the shales of the Ithaca and Hamilton series. The course of the upper portion of the stream is southeastward; at Binnewater it encounters the Onondaga limestone barrier and turns abruptly to the northeast, following the western margin of this formation closely to Glen Erie, where it breaks over the Onondaga and the sandstones of the Oriskany and Helderberg series, forming precipitous falls. Finally at Saugerties it cuts through the easily eroded Hudson River shales, making its descent to tide-water level of the Hudson in an abrupt fall of about 40 feet.

In general the notable falls in the stream occur at the transition from one geologic formation to another, as follows:

Falls in Esopus Creek.

Location.	Formation.		Approximate fall.
	From—	To—	
			Feet.
Olivebridge	Catskill	Ithaca	28
Glen Erie	Onondaga	Oriskany	56
Saugerties	Helderberg	Hudson River	40

Between Binnewater and Saugerties, a distance of about 20 miles, the course of the creek lies parallel to that of Hudson River, though the two streams flow in opposite directions. At Kingston the creek is 2.5 miles from the Hudson and at an elevation of 140 feet above tide.

A gaging station was established July 5, 1901, at the Washington Street Bridge over Esopus Creek at Kingston.

The channel is straight at the point of gaging, but curves a short distance above and below. The right bank is subject to overflow during high water, but at ordinary and low stages the flow is all confined in one channel.

A standard chain gage is attached to the bridge; length of chain, 31.04 feet. The gage is read twice each day by John Douglas. The bench mark is a cut on the upstream corner of the right-hand abutment; elevation, 31.73 feet above the datum of the gage.

In winter and at times when the stream was more or less obstructed by ice special discharge measurements have been made, from which a rating curve applicable to periods when the stream is frozen has been derived. This gives a discharge considerably smaller at a given stage of the stream than is indicated by a regular rating curve for the cross section derived from measurements in open section.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 63-64; 82, pp 107; 97, pp 165-166; 125, pp 66-67.
Discharge: 65, p 64; 82, p 108; 97, pp 166-168; 125, p 67.
Discharge, daily: 97, pp 174-175; 125, p 69.
Discharge, monthly: 65, p 65; 97, pp 175-176; 125, p 69.
Gage heights: 65, p 64; 82, pp 107, 109; 97, pp 168-170; 125, p 67.
Rating tables: 97, pp 171-173; 125, p 68.
Water powers: 65, p 66.

Discharge measurement of Esopus Creek at Kingston, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 13	C. C. Covert	78	156	0.30	3.82	46.6

Daily gage height, in feet, of Esopus Creek at Kingston, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.72	6.08	5.55	10.92	5.6	4.32	3.95	4.05	4.25	4.88	5.22	6.8
2	7.56	6.02	5.5	9.6	5.5	4.3	4.04	3.85	4.02	4.81	5.14	7.12
3	7.78	5.99	5.45	8.8	5.4	4.3	4.3	3.85	7.46	5.1	5.02	8.8
4	7.55	5.9	5.45	8.25	5.3	4.22	4.28	3.85	14.68	5.02	5.08	11.72
5	7.18	5.85	5.38	8.45	5.2	4.2	3.98	3.8	11.2	4.88	5.04	9.55
6	7.32	5.95	5.32	9.08	5.2	4.5	4.08	3.77	8.32	4.7	5.22	8.4
7	10.85	5.92	5.35	8.8	5.18	4.58	3.95	3.9	7.92	4.65	5.6	7.7
8	12.9	5.9	5.4	8.15	5.25	4.7	4.02	3.75	6.38	4.58	5.25	7.32
9	10.9	5.95	5.7	8.62	5.1	4.48	4.0	3.68	5.86	4.55	5.28	6.98
10	9.72	5.95	6.65	7.65	5.08	4.35	3.95	3.7	5.38	4.42	5.2	7.72
11	8.95	5.9	6.96	7.61	4.92	4.22	4.01	3.72	5.3	4.3	5.11	6.35
12	8.75	5.9	5.9	8.1	5.05	4.22	3.82	3.72	7.2	10.78	5.06	6.45
13	10.45	5.82	6.55	8.02	4.98	4.32	4.0	3.79	7.42	7.88	5.05	6.12
14	9.15	5.82	6.35	7.78	4.9	4.28	3.94	3.7	6.65	6.92	5.01	5.92
15	8.12	5.9	6.35	7.48	5.02	4.22	3.8	3.95	6.2	6.5	4.98	5.96
16	8.1	5.82	6.28	7.18	5.88	4.22	3.9	4.26	5.89	6.18	4.88	5.88
17	7.89	5.78	6.22	6.95	4.96	4.11	3.84	4.46	5.74	5.92	4.92	5.78
18	7.5	5.8	6.82	6.68	4.98	4.11	3.82	4.24	6.15	5.78	4.92	5.49
19	7.5	5.75	12.15	6.52	4.9	3.98	3.7	3.98	6.9	5.66	4.78	5.62
20	7.5	5.7	14.58	6.3	4.75	4.12	3.72	3.95	6.6	5.9	4.8	5.42
21	7.12	5.7	12.25	6.35	4.65	4.22	3.75	3.84	7.35	6.38	4.76	6.78
22	7.0	5.8	12.58	6.22	4.65	4.3	3.69	3.85	6.72	6.08	4.8	9.55
23	6.45	5.82	10.11	6.05	4.6	4.32	3.65	3.76	6.3	5.92	4.62	7.48
24	6.2	5.7	9.55	5.98	4.6	4.18	3.78	3.75	5.96	5.81	4.6	7.02
25	6.25	5.65	11.35	5.88	4.5	4.12	3.89	3.92	5.8	5.71	4.63	6.6
26	6.38	5.62	11.68	5.75	4.5	3.98	3.86	3.85	5.52	5.62	4.65	6.45
27	6.1	5.62	12.2	5.7	4.58	4.1	3.79	3.78	5.38	5.48	4.6	6.21
28	6.52	5.6	12.22	5.6	4.45	4.05	3.8	3.71	6.3	5.4	4.6	6.01
29	6.42	.....	12.45	5.6	4.4	3.98	3.72	3.72	5.14	5.22	5.71	6.63
30	6.3	.....	13.95	5.68	4.48	3.98	3.68	3.75	5.06	5.28	7.6	7.18
31	6.2	.....	12.62	.....	4.35	.....	3.82	3.88	.....	5.18	.....	6.58

NOTE.—Creek frozen over January 1 to March 19. Thickness of ice increased from 0.7 foot to 1.5 feet. Gage heights are to the surface of the water in a hole cut in the ice.

Station rating table for Esopus Creek at Kingston, N. Y., from July 5, 1901, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.50	8	4.70	200	5.90	498	8.00	1,373
3.60	22	4.80	220	6.00	527	8.50	1,640
3.70	36	4.90	240	6.20	596	9.00	1,940
3.80	49	5.00	260	6.40	665	9.50	2,275
3.90	63	5.10	285	6.60	741	10.00	2,642
4.00	77	5.20	309	6.80	823	10.50	3,030
4.10	94	5.30	334	7.00	905	11.00	3,440
4.20	110	5.40	358	7.20	995	12.00	4,340
4.30	127	5.50	383	7.40	1,085	13.00	5,305
4.40	143	5.60	412	7.60	1,179	14.00	6,280
4.50	160	5.70	441	7.80	1,276	15.00	7,310
4.60	180	5.80	469				

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–5. It is well defined between gage heights 3.8 feet and 11 feet. The table has been extended beyond these limits, being based on two measurements above 11 feet.

Estimated monthly discharge of Esopus Creek at Kingston, N. Y., for 1905.

[Drainage area, 324 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches
January	3,856	163	934	2.88	3.32
February	163	88	122	.377	.393
March	6,873	45	2,002	6.18	7.12
April	3,375	412	1,139	3.52	3.93
May	492	135	253	.781	.900
June	200	74	116	.358	.399
July	127	29	62.3	.192	.221
August	153	33	59.0	.182	.210
September	6,977	80	953	2.94	3.28
October	3,260	127	504	1.56	1.80
November	1,179	180	293	.904	1.01
December	4,088	363	1,007	3.11	3.58
The year	6,977	29	620	1.92	26.16

NOTE.—During frozen period the discharge is taken from special rating curve for ice conditions.

WAPPINGER CREEK NEAR WAPPINGER FALLS, N. Y.

Wappinger Creek rises in northern Dutchess County and flows southwestward into Hudson River at New Hamburg. The drainage basin comprises a hilly plateau, 400 to 600 feet above tide, nearly rectangular in shape and including numerous lakes and marsh areas. Winding, branched tributaries gather the run-off from the numerous hills which dot the area. About 16 miles from the mouth of the stream the basin becomes much narrower and the differences of elevation are of less magnitude. The stream flows near the right-hand side of a valley, 3 to 4 miles in width, the slope being gradual to Wappinger Falls, where it makes a sudden descent to nearly tide-water level, the elevation of Wappinger Pond being about 78 feet. The topography of the basin is shown on the Poughkeepsie, Rhinebeck, Millbrook, and Clove sheets of the United States Geological Survey topographic atlas, from which the following drainage areas have been determined:

Drainage areas of Wappinger Creek.

Point of measurement.	Area.	
	Place to place.	Total.
	Sq. miles.	*Sq. miles.*
East Branch Wappinger Creek above Stamfordville	40	40
East Branch above junction with West Branch	67.4	107.4
West Branch above mouth	33.8	33.8
Total area of East and West branches		141.2
Wappinger Creek above Van Wagners	33.8	175
Wappinger Creek above Central Falls	14.7	189.7
Wappinger Creek above gaging station	4.78	194.4
Wappinger Creek above Wappinger Falls	7.81	202.2
Wappinger Creek above mouth	13.7	215.9

But little power is developed on the stream. At Wappinger Falls a bleaching and dyeing establishment utilizes 22 feet fall.

A gaging station was established May 19, 1903, at the first highway bridge crossing Wappinger Creek above the village of Wappinger Falls. The gaging record was discontinued July 1, 1905.

The channel is straight for about 250 feet above and 300 feet below the bridge. The bed of the stream is of sand and gravel, with some bowlders. The bridge from which the gagings are made has two spans of 43.4 and 46.5 feet, respectively.

A graduated vertical scale attached to the central bridge pier was read twice each day by Lee Jackson. The bench mark is a spike in the root of a blazed tree on the south side of the road, 50 feet east of bridge; elevation above datum plane of gage, 9.19 feet.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 137; 125, p 70
Discharge: 97, p 137; 125, p 71.
Gage heights: 97, p 138; 125, p 71.

Discharge measurement of Wappinger Creek near Wappinger Falls, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 14	C. C. Covert	94	161	0.28	0.15	45.5

Daily gage height, in feet, of Wappinger Creek near Wappinger Falls, N. Y., for 1905.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	3.2	2.1	1.55	3.3	1.0	0.2	17	3.0	1.6	3.32	1.62	.78	.3
2	3.12	2.1	1.5	3.0	.95	.2	18	2.75	1.6	3.75	1.6	.75	.3
3	3.0	2.1	1.5	2.82	.95	.2	19	2.52	1.6	7.15	1.6	.7	.38
4	2.98	2.1	1.5	2.75	.9	.2	20	2.35	1.6	7.25	1.5	.65	.48
5	2.9	1.65	1.5	2.75	.85	.3	21	2.22	1.6	4.1	1.6	.6	.38
6	2.82	1.6	1.5	3.0	.82	.28	22	2.1	1.6	3.45	1.6	.55	.35
7	6.35	1.6	1.5	3.02	.8	.28	23	2.1	1.6	3.85	1.48	.5	.3
8	6.6	1.6	1.5	3.1	.8	.32	24	2.1	1.6	4.25	1.32	.48	.3
9	5.65	1.6	1.5	2.9	.8	.3	25	2.1	1.6	5.6	1.2	.42	.3
10	4.72	1.6	1.98	2.55	.85	.3	26	2.1	1.6	5.4	1.15	.35	.25
11	4.38	1.6	4.85	2.32	.8	.3	27	2.1	1.55	5.68	1.12	.3	.1
12	4.02	1.6	4.45	2.3	.8	.3	28	2.1	1.55	5.52	1.08	.3	.05
13	3.98	1.6	4.1	2.22	.88	.3	29	2.1	.....	4.65	1.0	.3	.0
14	3.8	1.6	3.75	1.98	.88	.3	30	2.1	.....	3.92	1.0	.25	.0
15	3.68	1.6	3.52	1.8	.85	.3	31	2.1	.....	3.68	.....	.25	.....
16	3.25	1.6	3.22	1.72	.82	.3							

NOTE.—Creek frozen February 1 to March 9 approximately. During this time the gage was read to surface of water in hole cut in ice. The following comparative readings were also made:

Date.	Water surface.	Top of of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 7	1.6	1.8	1.0
February 11	1.6	1.8	1.0
February 14	1.6	1.8	1.0
February 18	1.6	1.8	1.0
February 21	1.6	1.8	1.0
February 28	1.55	1.8	1.0
March 8	1.5	1.8	1.0

DELAWARE AND HUDSON CANAL AT CREEKLOCKS, N. Y.

The Delaware and Hudson Canal runs parallel to Rondout Creek from the feeder dam below High Falls to tide water at Eddyville. The canal receives its entire water supply from Rondout Creek. The section from High Falls to Eddyville is the only portion of the canal remaining in operation in New York State. At Rosendale the canal carries a portion of the yield of Rondout Creek past the gaging station.

In order to determine the run-off from the Rondout Creek drainage basin, gagings of the flow in the Delaware and Hudson Canal at the foot of the Rosendale level have been undertaken. The diversion to the canal, added to the measured discharge of Rondout gaging station, represents the total flow from the drainage basin.

The discharge of the canal was determined from observations of the depth of flow over the waste weir, of the number of lockages, and of the opening of the lock gates. Observations were made from June, 1901, to December, 1903, inclusive, and were resumed in December, 1905. The observations in 1905 have been made in cooperation with the New York water-supply commission.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 113; 97, p 152.
Discharge, daily: 97, p 152.
Diversion from Rondout Creek: 65, pp 68-69; 82, p 114; 97, p 153.

RONDOUT CREEK AT ROSENDALE, N. Y.

This station was established July 6, 1901, at the highway bridge at Rosendale, discontinued November 7, 1903, and reestablished in December, 1905, in cooperation with the New York water-supply commission.

The Delaware and Hudson Canal, now abandoned above High Falls, draws its water supply for the section from High Falls to Eddyville from Rondout Creek at the feeder dam above Rosendale. The flow in the canal is therefore to be added to that at the gaging station to obtain the total run-off from the drainage area above this point.

The bed of the channel is composed of rock. The entire discharge, with the exception of the diversion into the canal, passes under the highway bridge at all stages.

Discharge measurements are made from the bridge, except at low water, when they are made by wading at a ford 1 mile downstream. The bridge has a single span of 136 feet.

Gage readings are made twice each day by means of a chain gage supported by outriggers fastened to the floor beams near the center of the downstream side of the bridge. The bench mark is a circle cut in the upstream corner of the bridge seat on the right-hand abutment. Its elevation is 32.03 feet above gage datum. The observer is Anna Huben.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 66-67; 82, p 111; 97, p 153.
Discharge: 65, p 68; 82, p 112; 97, pp 154-155.
Discharge, daily: 97, pp 161-163.
Discharge, monthly: 97, p 164.
Diversions from, to Delaware and Hudson Canal: 82, p 114.
Gage heights: 65, p 68; 82, pp 111, 113; 97, pp 156-158.
Rainfall data: 97, p 164.
Rating table: 97, pp 159-160.

Discharge measurement of Rondout Creek at Rosendale, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
Aug. 14	C. C. Covert	107	449	0.14	6.12	62

MISCELLANEOUS MEASUREMENTS IN HUDSON RIVER DRAINAGE BASIN.

The following discharge measurements have been made in the Hudson River basin in 1905:

Miscellaneous discharge measurements in the Hudson River basin in 1905.

Date.	Stream.	Place.	Hydrographer.	Width.	Area of section.	Mean velocity	Gage height.	Discharge.
				Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
Aug. 12	Esopus Creek.	Near Olivebridge.	C. C. Covert	136	177	2.80	.087	49.5
Aug. 14	Walkill River.	At Newpaltz	do	111	599	.19	5.70	115

PASSAIC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Passaic River rises in Somerset and Morris counties, N. J. Above its confluence with Pompton River, its main tributary, it meanders through a flat country of Triassic red sandstone, to which in large measure must be attributed the turbidity of its waters. In contrast with the sluggish, muddy character of the Passaic, the Pompton is a rapid stream, and its waters are clear. It drains parts of Sussex, Passaic, Morris, and other adjoining counties, and traverses for a large part of its course a country of hard crystalline rocks and heavy forests, the general level of which is several hundred feet above that of the Passaic. At their confluence the Pompton enters with a current which carries it well toward the right bank of the Passaic, and at times of flood causes much backwater in the latter.

The flow of the Passaic is of special interest from the fact that several large cities in its drainage basin take their public supply from it, and because of the valuable water-power privileges along its course, particularly at the city of Paterson. Several cities, including Paterson and Passaic, throw their sewage into this stream, and in the lower part of its course it becomes so polluted as to be offensive to property holders along its banks, and to seriously interfere with the comfort and health of the inhabitants of several towns.

The highest recorded flood which has occurred in this drainage basin was that of October, 1903. The flood began at 6.30 p. m. October 8 and lasted until midnight October 18, the maximum height being reached at 9 p. m., October 10. There was a total rainfall of 11.74 inches between October 8 and 11. The estimated maximum discharge at the Dundee dam was 35,800 second-feet. This flood is fully described in Water-Supply Paper No. 92.

During 1905 the United States Geological Survey maintained gaging stations in this basin as follows:

Passaic River at Millington and near Chatham, N. J.
Ramapo River near Mahwah, N. J.
Wanaque River near Wanaque, N. J.

PASSAIC RIVER AT MILLINGTON, N. J.

This station was established November 25, 1903, by F. H. Tillinghast. It is located at the lower highway bridge at Millington, N. J.

The channel is straight for 600 feet above and 200 feet below the station. Both banks are high and are not subject to overflow. The bed of the stream is composed of gravel, with a few scattered bowlders, and is permanent. The section is shallow. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the old wooden truss bridge to which the gage is attached. The bridge has a span of 69.7 feet. The initial point for soundings is the vertical face of the right abutment on the downstream side.

A standard chain gage is fastened to the wooden hand rail on the downstream side of the bridge. The gage is read twice each day by Mary I. Bray. The pulley wheel is located at a point 24 feet from the right abutment. The length of the chain from the end of the weight to the marker is 14.13 feet. Bench mark No. 1 is a square chiseled on the corner of the right abutment at the downstream side. Its elevation is 11.82 feet above gage datum. Bench mark No. 2 is the top of a nail 2 feet from the ground in an elm tree 150 feet east of the bridge. Its elevation is 13.57 feet above gage datum. Bench mark No. 3 is the top of the circular iron tension bar directly under the pulley. Its elevation is 8.97 feet above gage datum. Bench mark No. 4 is the top of the wooden rail of the bridge at the pulley. Its elevation is 13.44 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 237-238; 125, p 74.
Discharge: 82, p 127; 97, p 238; 125, p 74.
Gage heights: 97, p 238; 125, p 75.

Discharge measurement of Passaic River at Millington, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 21	R. H. Bolster	54	23.6	0.54	1.12	12.8

Daily gage height, in feet, of Passaic River at Millington, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25	2.72	2.75	2.32	1.45	1.22	1.1	1.25	1.15	1.3	1.35	2.55
2	2.28	2.68	2.75	2.18	1.4	1.2	1.1	1.22	1.15	1.25	1.3	2.38
3	2.35	2.62	2.75	2.02	1.4	1.2	1.2	1.1	2.15	1.35	1.3	2.58
4	2.3	2.58	2.75	1.9	1.4	1.2	1.18	1.1	3.15	1.28	1.3	2.92
5	2.22	2.48	2.7	2.52	1.4	1.2	1.1	1.05	3.18	1.25	1.3	2.4
6	2.15	2.38	2.7	2.9	1.4	1.2	1.15	1.05	2.75	1.25	1.3	2.32
7	5.62	2.35	2.7	2.68	1.4	1.32	1.1	1.1	2.38	1.2	1.3	2.08
8	7.3	2.35	2.78	2.45	1.35	1.4	1.1	1.05	2.15	1.2	1.3	1.8
9	7.02	2.35	3.28	2.32	1.35	1.32	1.1	1.05	1.78	1.2	1.25	1.72
10	5.38	2.35	3.88	2.2	1.3	1.28	1.1	1.1	1.55	1.2	1.25	1.72
11	4.12	2.35	4.58	2.08	1.3	1.25	1.1	1.1	1.50	1.25	1.25	1.75
12	3.48	2.35	4.8	2.02	1.3	1.25	1.1	1.05	3.0	1.55	1.25	1.62
13	3.78	2.65	4.6	1.95	1.6	1.35	1.1	1.1	3.12	1.38	1.25	1.58
14	4.6	2.75	4.58	1.88	1.62	1.25	1.1	1.1	2.7	1.3	1.22	1.52
15	5.18	2.75	4.48	1.82	1.52	1.2	1.1	1.62	2.42	1.25	1.2	1.72
16	4.55	2.75	4.5	1.78	1.45	1.2	1.05	2.38	2.18	1.2	1.2	1.95
17	3.2	2.75	4.85	1.7	1.42	1.2	1.05	2.35	1.85	1.2	1.2	1.6
18	2.82	2.75	5.05	1.65	1.48	1.2	1.05	2.15	1.82	1.18	1.18	1.5
19	2.48	2.75	5.2	1.62	1.42	1.22	1.05	1.85	2.2	1.25	1.2	1.45
20	2.2	2.75	5.5	1.58	1.42	1.2	1.0	1.55	2.15	1.9	1.22	1.38
21	2.15	2.75	5.7	1.62	1.38	1.18	1.0	1.45	2.12	2.22	1.15	2.42
22	1.9	2.75	5.7	1.75	1.35	1.22	.95	1.38	2.02	1.95	1.18	3.1
23	2.12	2.75	5.05	1.7	1.3	1.58	1.0	1.28	1.88	1.78	1.18	2.82
24	2.0	2.75	4.15	1.62	1.3	1.45	1.05	1.2	1.65	1.62	1.18	2.78
25	2.85	2.75	4.0	1.6	1.3	1.32	1.05	1.3	1.58	1.55	1.22	2.4
26	2.9	2.75	3.7	1.58	1.3	1.25	1.05	1.52	1.48	1.52	1.18	2.2
27	2.95	2.75	3.52	1.58	1.3	1.2	1.05	1.35	1.38	1.48	1.18	1.98
28	2.95	2.75	3.22	1.52	1.3	1.15	1.0	1.25	1.35	1.45	1.15	1.8
29	2.9	.....	2.9	1.5	1.28	1.1	1.4	1.2	1.32	1.4	1.9	2.22
30	2.8	.....	2.68	1.5	1.25	1.1	1.55	1.2	1.3	1.4	3.08	2.4
31	2.8	.....	2.52	.....	1.25	.....	1.35	1.18	.....	1.35	.....	2.12

NOTE.—River frozen January 1-6. From January 26 to March 17 river frozen entirely across, and gage read to top of ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 18	2.6	2.75	1.2
February 21	2.65	2.75	1.3
February 25	2.65	2.75	1.25
March 2	2.6	2.75	1.2

PASSAIC RIVER NEAR CHATHAM, N. J.

This station was established February 10, 1903, by the United States Weather Bureau, by which it is maintained. It is located at the second bridge, about 1.5 miles upstream from Chatham, N. J.

The channel is straight for 400 feet above and below the station. At low water the current makes a small angle with the normal to the cross section, caused by a small island just below the bridge. Two hundred feet above the bridge is an old timber dam, partly washed away. Both banks are high and wooded and are not liable to overflow. The bed of the stream is composed of gravel, with occasional bowlders.

Discharge measurements are made from the single-span steel highway bridge, to which the gage is attached. The downstream side is marked every 5 feet. The initial point for soundings is the base of the right abutment.

The original gage consists of a vertical staff spiked to the upstream wing wall of the right abutment. December 12, 1903, a standard chain gage was installed on the downstream side of the bridge. The length of the chain from the end of the weight to the marker is 15.59 feet. The gage is read once each day by M. A. Butler. Bench mark No. 1 for the new gage is the corner of the top of the right abutment on the upstream side. Its elevation is 10.31 feet above gage datum. Bench mark No. 2 is the upper surface of the lower chord directly under the pulley. Its elevation is 9.19 feet above gage datum. Bench mark No. 3 is the top of the first bolt on the coping of the downstream wing wall, right-hand abutment. Its elevation is 10.64 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 236; 125, p 76.
Discharge: 97, p 236; 125, p 76.
Gage heights: 97, p 237; 125, p 77.

Discharge measurements of Passaic River near Chatham, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 22	R. H. Bolster	70	80	0 21	2.32	17.0
July 10	N. C. Grover	64	55	.29	2.25	15.8

Daily gage height, in feet, of Passaic River near Chatham, N. J., for 1905.

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.2	.....	3.2	2.5	2.2	2.3	3.1	2.3	2.3	2.3	3.8
2	3.2	.....	3.2	2.4	2.4	2.4	2.6	2.3	2.3	2.3	3.2
3	3.2	.....	3.2	2.5	2.3	2.3	2.3	2.8	2.3	2.2	3.4
4	.....	.....	3.0	2.4	2.2	2.2	2.1	4.8	2.2	2.2	3.7
5	.....	.....	3.5	2.4	2.3	2.3	2.0	5.0	2.2	2.2	3.5
6	.....	.....	4.1	2.5	2.2	2.2	2.0	4.6	2.2	2.2	3.3
7	6.0	.....	3.8	2.3	2.4	2.2	2.0	4.1	2.1	2.2	3.2
8	8.0	.....	3.5	2.3	2.6	2.2	2.0	3.7	2.1	2.2	3.1
9	8.3	.....	3.5	2.4	2.5	2.1	2.0	3.4	2.1	2.2	3.0
10	7.8	4.1	3.3	2.3	2.4	2.1	2.1	2.8	2.1	2.2	3.0
11	7.3	5.0	3.3	2.3	2.5	2.2	2.1	2.4	2.0	2.1	2.9
12	6.9	5.9	3.3	2.4	2.4	2.2	2.0	4.5	2.5	2.1	2.9
13	6.5	5.9	3.0	2.5	2.5	2.2	2.0	4.3	2.4	2.1	2.8
14	6.3	5.6	2.9	2.6	2.6	2.2	2.0	4.0	2.4	2.1	2.7
15	6.3	5.5	3.0	2.7	2.4	2.2	2.2	3.7	2.3	2.1	2.5
16	.....	5.6	2.8	2.5	2.4	2.2	4.3	3.3	2.3	2.1	2.4
17	.....	6.4	2.8	2.5	2.4	2.1	4.1	3.0	2.2	2.2	2.4
18	.....	5.0	2.8	2.7	2.3	2.1	3.8	2.9	2.2	2.2	2.3
19	.....	5.1	2.6	2.5	2.2	2.1	3.4	3.2	2.2	2.2	2.3
20	4.7	5.2	2.6	2.5	2.3	2.1	3.0	3.1	2.8	2.2	2.2
21	4.6	6.0	2.6	2.6	2.2	2.1	2.7	3.2	3.6	2.1	2.9
22	4.3	5.9	2.9	2.4	2.2	2.1	2.5	3.0	3.0	2.1	4.0
23	3.9	5.6	2.8	2.4	2.6	2.1	2.3	2.9	2.9	2.1	4.1
24	3.7	5.3	2.8	2.5	2.7	2.2	2.2	2.7	2.7	2.1	4.0
25	.....	5.2	2.6	2.4	2.6	2.2	2.5	2.6	2.6	2.1	3.9
26	.....	4.7	2.6	2.3	2.7	2.2	2.9	2.6	2.6	2.1	3.7
27	.....	4.4	2.7	2.4	2.5	2.2	2.8	2.5	2.5	2.1	3.4
28	.....	4.3	2.5	2.3	2.5	2.2	2.7	2.5	2.5	2.1	3.1
29	.....	3.9	2.5	2.2	2.5	2.2	2.6	2.4	2.4	3.0	3.6
30	.....	3.7	2.6	2.3	2.4	2.9	2.5	2.4	2.4	3.9	3.8
31	.....	3.5	.....	2.2	.....	3.4	2.4	.....	2.3	.....	.....

NOTE.—January 4-6 and 16-19 river frozen at gage. January 25 to March 9 river frozen entirely across; no readings taken. March 10-17 river blocked with ice.

Station rating table for Passaic River near Chatham, N. J., from March, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	2	2.80	101	3.60	351	4.40	708
2.10	4	2.90	124	3.70	391	4.50	758
2.20	9	3.00	149	3.80	433	4.60	809
2.30	17	3.10	176	3.90	476	4.70	861
2.40	29	3.20	206	4.00	520	4.80	914
2.50	44	3.30	239	4.10	565	4.90	968
2.60	61	3.40	274	4.20	611	5.00	1,022
2.70	80	3.50	312	4.30	659		

The above table is applicable only for open channel conditions. It is based on 13 discharge measurements made during 1903-5 between gage heights 2.28 feet and 3.8 feet. It is well defined between these gage heights. Below gage height 2.25 feet and above gage height 4.5 feet the rating curve is a rough approximation.

Estimated monthly discharge of Passaic River near Chatham, N. J., for 1903–1905.

[Drainage area, 101 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
February 10–28	1,302	206	610	6.04	4.27
March	1,770	124	674	6.67	7.69
April	1,077	61	381	3.77	4.21
May	44	2	7.5	.074	.085
June	1,132	2	334	3.31	3.69
July	611	17	158	1.56	1.80
August	914	29	288	2.85	3.29
September	1,188	29	329	3.26	3.64
October	2,312	17	576	5.70	6.57
November	176	29	71.5	.708	.790
December	1,132	17	372	3.68	4.24
1904.					
March 11–31	1,022	149	348	3.45	2.69
April	861	61	253	2.50	2.79
May	312	17	92.8	.919	1.06
June	149	4	46.9	.464	.518
July	176	4	37.7	.373	.430
August	809	17	256	2.53	2.92
September	1,593	4	261	2.58	2.88
October	809	17	169	1.67	1.92
November	433	44	114	1.13	1.26
December 1–8	29	17	23.0	.228	.068
1905.					
January 17 days	2,986	206	1,400	13.86	8.79
March 18–31	1,593	312	960	9.50	4.95
April	565	44	169	1.67	1.86
May	80	9	34.7	.344	.397
June	80	9	34.1	.338	.377
July	274	4	21.2	.210	.242
August	708	2	96.9	.959	1.11
September	1,022	17	276	2.73	3.05
October	391	2	43.5	.431	.497
November	476	4	27.4	.271	.302
December	565	9	234	2.32	2.68

NOTE.—Frozen February 20 and December 4–5, 1903; discharge interpolated. Ice conditions January 1 to March 10, December 9–31, 1904, and January 4–6, 16–19, 25–31, February 1 to March 17, 1905, no estimates made.

RAMAPO RIVER NEAR MAHWAH, N. J.

This station was established February 10, 1903, by the United States Weather Bureau, by which it is maintained. It is located at a concrete-arch highway bridge about 1 mile west of Mahwah, N. J.

The channel is straight for 300 feet above and 200 feet below the bridge. About 200 feet below the bridge there is a rift with about 1 foot fall. The right bank is low, and during high water the lowlands on this side of the river are flooded. The left bank is high, wooded, and not liable to overflow. The bed of the stream is composed of gravel and scattered bowlders, and there is but one channel.

Discharge measurements are made from the upstream side of the bridge to which the gage is attached. The bridge has a single span of 68 feet between abutments. The initial point for soundings is the end post of the hand rail on the left bank.

A standard chain gage is bolted to the hand rail on the downstream side of the bridge. The length of the chain from the end of the weight to the marker is 20.65 feet. The gage is read once each day by M. F. Brooks. Bench mark No. 1 is a cross chiseled on the coping of the upstream parapet wall at the left bank. Its elevation is 17.72 feet above gage datum. Bench mark No. 2 is a square chiseled on the edge of the coping 3.5 feet west of the gage pulley. Its elevation is 17.43 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 229; 125, pp 79-80.
Discharge: 82, p 127; 97, p 229; 125, p 80.
Discharge, monthly: 125, pp 81-82.
Gage heights: 97, p 230; 125, p 80.
Rating table: 125, p 81.

Discharge measurement of Ramapo River near Mahwah, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 23	R. M. Packard	52	216	0.87	3.68	188

Daily gage height, in feet, of Ramapo River near Mahwah, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.9	.....	3.4	5.0	3.4	3.0	2.9	3.2	2.7	2.9	3.2	3.8
2	4.0	.....	3.3	4.6	3.4	3.0	2.9	3.1	2.7	2.9	3.2	3.5
3	4.0	.....	3.3	4.4	3.4	3.0	3.1	3.0	3.2	3.0	3.1	3.7
4	4.0	3.1	3.3	4.4	3.3	3.0	3.0	2.8	4.5	2.9	3.1	4.7
5	.....	.....	3.3	4.6	3.3	3.0	2.9	2.7	5.0	2.9	3.0	4.2
6	.....	.....	3.3	5.0	3.3	2.9	2.8	2.7	4.2	3.8	3.0	3.9
7	6.2	.....	3.3	4.8	3.3	2.9	3.0	2.7	3.7	2.8	3.1	3.8
8	7.3	.....	3.3	4.6	3.2	2.9	2.8	2.7	3.4	2.8	3.1	3.7
9	6.5	.....	3.8	4.4	3.2	2.9	2.8	2.7	3.2	2.8	3.0	3.6
10	5.4	.....	4.1	4.3	3.2	2.9	2.8	2.7	3.2	2.8	3.0	3.7
11	5.1	3.1	4.4	4.3	3.2	2.9	2.8	2.8	3.1	2.7	3.0	3.6
12	4.7	.....	4.3	4.3	3.2	2.9	3.1	2.8	4.1	4.0	3.0	3.5
13	5.0	.....	4.1	4.2	3.2	3.7	3.0	2.7	3.8	3.8	3.0	3.5
14	4.9	.....	4.1	4.1	3.3	3.3	3.0	2.7	3.5	3.5	3.0	3.5
15	4.4	.....	4.0	4.0	3.3	3.1	3.0	2.7	3.3	3.3	3.0	3.5
16	4.2	.....	4.0	4.0	3.3	3.0	2.8	3.4	3.2	3.2	3.0	3.4
17	4.1	.....	4.1	3.9	3.3	2.9	2.8	3.1	3.1	3.2	2.9	(a)
18	4.1	3.1	4.3	3.9	3.3	2.9	2.8	3.0	3.5	3.2	2.9	3.4
19	4.0	.....	5.5	3.9	3.2	2.9	2.8	2.9	3.9	3.1	2.9	3.4
20	4.0	.....	6.4	3.7	3.2	2.9	2.8	2.9	3.8	3.5	2.9	3.3
21	4.0	.....	5.8	3.8	3.1	3.2	2.7	2.8	3.6	4.2	2.9	3.5
22	3.9	.....	6.1	3.8	3.1	3.2	2.6	2.8	3.5	3.7	2.9	5.1
23	3.8	3.2	6.0	3.7	3.0	3.8	2.7	2.8	3.2	3.6	2.8	4.6
24	3.8	3.3	5.8	3.6	2.9	3.8	2.7	2.7	3.2	3.4	2.8	4.4
25	3.7	3.3	6.2	3.5	2.9	3.4	2.7	2.6	3.2	3.4	3.0	4.0
26	3.1	3.4	6.4	3.5	2.9	3.2	2.7	2.8	3.1	3.4	2.9	4.0
27	.....	3.4	6.2	3.5	2.9	3.1	2.7	2.8	3.1	3.3	2.9	3.8
28	.....	3.4	6.2	3.5	2.9	3.0	2.7	2.7	3.0	3.2	2.9	3.8
29	.....	.....	5.8	3.4	2.9	3.0	2.6	2.7	3.0	3.2	3.5	4.0
30	.....	.....	5.4	3.5	2.9	2.9	2.7	2.7	3.0	3.2	4.4	4.4
31	.....	.....	5.3	.....	2.9	.....	3.6	2.7	.....	3.2	.....	4.2

a Frozen.

NOTE.—January 5-6 and January 26 to February 22 river frozen entirely across; ice 0.9 to 1 foot thick; weekly readings to surface of water in hole in ice. February 23 to March 3 ice broke up and went out.

Station rating table for Ramapo River near Mahwah, N. J., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.60	24	3.40	119	4.20	371	5.00	743
2.70	30	3.50	142	4.30	413	5.20	850
2.80	37	3.60	167	4.40	456	5.40	961
2.90	46	3.70	194	4.50	500	5.60	1,075
3.00	56	3.80	224	4.60	546	5.80	1,191
3.10	68	3.90	257	4.70	593	6.00	1,310
3.20	82	4.00	293	4.80	641		
3.30	99	4.10	331	4.90	691		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904-5 between gage heights 2.65 feet and 6 feet. It is fairly well defined between these limits.

Estimated monthly discharge of Ramapo River near Mahwah, N. J., for 1905.

[Drainage area, 118 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
February 23-28	119	82	106	0.899	0.201
March	1,560	99	670	5.68	6.55
April	743	119	342	2.90	3.24
May	119	46	79.5	.674	.777
June	224	46	74.7	.633	.706
July	167	24	44.5	.377	.435
August	119	24	41.3	.350	.404
September	743	30	158	1.34	1.50
October	371	30	109	.924	1.07
November	456	37	71.3	.604	.674
December	796	99	257	2.18	2.51

NOTE.—Ice conditions January 1 to February 22; no estimates made.

WANAQUE RIVER AT WANAQUE, N. J.

This station was established December 16, 1903, by F. H. Tillinghast. It is located at the highway bridge just above the Erie Railroad bridge and below the factory of the Wanaque River Paper Company.

The channel is straight for 300 feet above and 200 feet below the station. The current is sluggish at low water. The right bank is high, rocky, and wooded, while the left bank is low. The bed of the stream is composed of gravel, with occasional bowlders. All of the water passes under the bridge at all stages. At ordinary stages the depth of water at the gaging station is from 2 to 5 feet.

Discharge measurements are made from the upstream side of the single-span highway bridge, which has a length between abutments of 98.5 feet. The initial point for soundings is the face of the right abutment on the upstream side.

A standard chain gage is located on the upstream side of the bridge. The length of the chain from the end of the weight to the marker is 17.52 feet. The gage is read twice daily by J. Herbert Hunter. Bench mark No. 1 is a circular chisel draft on the upstream side of the right abutment. Its elevation is 13.80 feet above gage datum. Bench mark No. 2 is a square chiseled on the upstream edge of the last stone upstream of the right-abutment wing wall. Its elevation is 14.21 feet above gage datum. Bench mark No. 3 is the upper edge of the lower chord on the upstream side of the bridge, 1.1 feet from the down-spout. Its elevation is 13.58 feet above gage datum.

This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 230-231; 125, pp 82-83.
Discharge: 125, p 83.
Gage heights: 125, p 83.

Discharge measurement of Wanaque River at Wanaque, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 24	R. H. Bolster	81	212	0.27	1.16	58

Daily gage height, in feet, of Wanaque River at Wanaque, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.9	1.39	3.1	1.5	1.25	1.08	1.23	0.9	1.15	1.8	1.32
2	1.92	1.86	1.44	2.8	1.4	1.25	1.0	1.18	.95	1.12	1.32	1.25
3	2.08	1.72	1.46	2.65	1.38	1.31	.....	1.2	1.45	1.12	1.29	1.25
4	1.55	1.59	1.46	2.58	1.35	1.3	.....	1.1	2.0	1.15	1.25	1.2
5	1.82	[a] 1.54	1.4	2.75	1.4	1.25	1.0	.95	1.8	1.1	1.15	1.22
6	1.88	1.7	1.4	3.02	1.4	1.25	.95	.95	1.4	1.0	1.25	1.18
7	7.25	1.65	1.45	2.71	1.4	1.2	.9	1.05	1.25	1.05	1.25	[b] 1.16
8	5.7	1.54	1.47	2.55	1.38	1.22	.95	.9	1.1	1.1	1.2	1.14
9	4.3	1.6	1.45	2.55	1.4	1.18	.95	.98	1.1	1.18	1.17	1.12
10	3.82	1.75	1.9	2.5	1.35	1.15	1.0	.95	1.15	1.35	1.1	1.1
11	3.32	1.62	2.1	2.3	1.3	1.2	1.05	.9	1.25	1.4	1.15	1.19
12	3.3	1.68	2.16	2.2	1.32	1.2	1.05	.95	1.55	1.3	1.0	1.15
13	3.3	1.57	2.1	2.15	1.5	1.62	1.05	1.29	1.7	1.25	1.05	1.12
14	2.8	1.65	1.98	2.12	1.45	1.35	1.0	1.25	1.35	1.25	1.1	1.15
15	2.38	1.57	2.0	2.25	1.4	1.35	.9	1.3	1.25	1.2	1.12	1.1
16	2.3	1.55	2.1	1.95	1.4	1.28	1.0	1.35	1.3	1.2	1.15	1.1
17	2.2	1.62	2.19	1.95	1.3	1.25	1.1	1.14	1.35	1.4	1.2	1.34
18	2.24	1.5	2.26	1.92	1.34	1.2	1.02	1.05	1.45	1.68	1.16	1.5
19	2.18	1.45	3.5	1.8	1.38	1.07	.93	1.0	1.6	1.75	1.15	1.65
20	2.15	1.48	4.48	1.85	1.4	1.05	.95	.9	1.5	1.5	1.15	1.9
21	2.04	1.45	4.99	1.98	1.45	1.0	.95	.85	1.45	1.45	1.1	2.24
22	1.85	1.52	4.78	1.95	1.4	1.2	.98	.88	1.35	1.4	1.12	2.15
23	1.7	1.55	4.5	1.85	1.2	2.05	.95	.8	1.3	1.3	1.0	2.4
24	1.72	1.7	4.35	1.8	1.2	1.3	1.02	.89	1.2	1.35	1.05	2.5
25	1.9	1.74	4.69	1.65	1.28	1.25	1.0	.98	1.2	1.35	1.0	2.61
26	1.97	1.68	4.75	1.65	1.25	1.22	1.05	.95	1.2	1.35	.9	2.7
27	2.1	1.65	4.75	1.65	1.25	1.2	.95	.85	1.15	1.28	.8	2.7
28	2.19	1.56	4.35	1.52	1.25	1.14	1.0	.8	1.12	1.25	.95	2.65
29	[c] 2.7	.....	3.98	1.55	1.3	1.0	1.15	.9	1.1	1.37	1.65	2.5
30	2.26	.....	3.04	1.56	1.22	1.1	1.2	.95	1.1	1.35	1.54	2.52
31	2.09	.....	3.3	.....	1.3	.....	1.25	.9	.....	1.35	.....	2.4

[a] February 5 channel clear.
[b] Gage height interpolated December 7–9, inclusive.
[c] January 29 river frozen over except for narrow strip.

RARITAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Raritan River, the largest stream in New Jersey except the Delaware, is formed by two chief branches, North and South, which have their sources a few miles apart in the highlands of Morris County, flow southward, and unite near Somerville, from which point the course of the river is southeastward to Raritan Bay. The river is tidal to a point about 2 miles above New Brunswick, and is navigable to that city, about 12 miles from the mouth.

The total area of the drainage basin is 1,105 square miles, about 10 per cent of which is forested. The highlands consist mostly of trap rock and contain a large proportion of the

wooded areas of the basin. The area outside of the highlands consists either of trap rock or red sandstone. Of the 800 square miles of drainage area above the gaging station at Bound Brook, about 150 square miles are in the cultivated part of the highlands and on the trap ridges; the remainder is mostly on the low, level, red-sandstone plain.

The valley of the Raritan is populous and highly cultivated, and a large amount of water power is utilized on its various branches. North Branch is considered a valuable source for a gravity supply, the elevation of the upper portion ranging from 750 to 1,100 feet. Millstone River, an important stream, which unites with the Raritan a few miles west of Bound Brook, differs from the other branches, having its rise in sand hills and flowing northwestward through a sandy soil. It has large ground storage, and is better suited for power than for water supply, being very muddy at high stages.

The United States Geological Survey maintained gaging stations in this basin during 1905 as follows:

South Branch Raritan River at Stanton, N. J.
North Branch Raritan River near Pluckemin, N. J.
Raritan River at Finderne and Bound Brook, N. J

SOUTH BRANCH RARITAN RIVER AT STANTON, N. J.

This station was established July 2, 1903, by E. P. Roundey. It is located at the highway bridge about 500 feet from the Lehigh Valley Railroad station at Stanton, N. J.

The channel is straight for 800 feet above and 400 feet below the station. Both banks are low and liable to overflow. The bed of the stream is composed of gravel.

Discharge measurements are made from the downstream side of the single-span highway bridge. The initial point for soundings is the face of the right abutment.

A standard chain gage is located on the lower chord of the bridge on the downstream side. The length of the chain from the end of the weight to the marker is 14.63 feet. The gage is read twice each day by William Wilson, the station agent. Bench mark No. 1 is a square chiseled on the coping of the left abutment, 1.5 feet from the downstream end. It is 13.37 feet above gage datum. Bench mark No. 2 is the top of the upstream corner of the right abutment. It is 13.665 feet above gage datum. Bench mark No. 3 is a nail projecting one-fourth inch from the downstream side of a large sycamore tree 210 feet below the bridge and is 6 feet above the ground. Elevation, 11.024 feet above gage datum. Bench mark No. 4 is a nail at the 8.5-foot mark of a secondary gage spiked to the same sycamore tree. Elevation, 8.164 feet above gage datum. Bench marks Nos. 2 and 4 are used to obtain the slope of the water surface at the station. They are 236 feet apart.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 244-245; 125, pp 85-86.
Discharge: 97, p 245; 125, p 86.
Discharge, monthly: 125, p 87.
Gage heights: 97, p 245; 125, p 86
Rating table: 125, p 87.

Discharge measurements of South Branch Raritan River at Stanton, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 17	F. H. Tillinghast	99	262	2.28	3.90	599
June 20	R. M. Packard	80	99	.50	2.13	49

Daily gage height, in feet, of South Branch Raritan River at Stanton, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.39	3.24	3.97	3.49	2.74	2.29	2.22	2.28	2.26	2.46	2.46	3.32
2	3.41	3.25	3.95	3.44	2.71	2.26	2.22	2.21	2.85	2.54	2.4	3.12
3	3.37	3.26	3.95	3.41	2.69	2.29	2.19	2.22	3.41	2.48	2.4	3.01
4	3.39	3.26	3.93	3.39	2.66	2.31	2.21	2.14	4.61	2.56	2.38	2.96
5	3.39	3.25	3.93	3.96	2.65	2.28	2.09	2.2	3.66	2.48	2.3	2.89
6	3.41	3.28	3.96	3.56	2.64	2.29	2.2	2.21	3.61	2.39	2.41	2.81
7	9.46	3.27	3.97	3.49	2.64	2.25	2.24	2.22	3.58	2.44	2.36	2.66
8	5.77	3.37	4.13	3.34	2.64	2.28	2.26	2.24	3.62	2.51	2.38	2.7
9	4.29	3.32	4.93	3.29	2.65	2.29	2.28	2.21	3.33	2.52	2.35	2.64
10	3.77	3.37	5.41	3.31	2.64	2.25	2.27	2.25	2.51	2.45	2.32	2.71
11	3.35	3.42	5.55	3.29	2.61	2.29	2.24	2.24	2.46	2.84	2.32	2.64
12	3.33	3.56	4.01	3.24	2.6	2.59	2.32	2.25	5.28	3.07	2.28	2.6
13	3.35	3.7	4.0	3.09	2.6	2.88	2.2	2.26	4.32	2.94	2.31	2.54
14	3.41	3.78	3.59	3.14	2.56	2.56	2.24	2.24	4.08	2.81	2.36	2.49
15	3.42	4.08	3.3	3.14	2.58	2.4	2.24	2.72	3.7	2.79	2.34	2.42
16	3.42	3.94	3.73	3.05	2.5	2.2	2.25	3.22	3.26	2.79	2.32	2.41
17	3.38	3.91	3.76	3.09	2.49	2.18	2.26	2.52	3.04	2.81	2.36	2.39
18	3.46	3.93	4.28	3.0	2.46	2.2	2.26	2.31	3.32	2.78	2.32	2.41
19	3.51	3.95	5.75	2.98	2.45	2.46	2.24	2.24	3.18	2.65	2.32	2.39
20	3.84	3.96	5.3	2.95	2.46	2.25	2.21	2.26	3.24	2.68	2.24	2.38
21	3.86	4.23	5.41	2.94	2.45	2.21	2.2	2.22	3.06	2.65	2.31	4.51
22	3.56	4.01	5.02	2.95	2.48	2.28	2.19	2.24	3.22	2.6	2.24	4.22
23	3.28	4.0	5.0	2.92	2.46	2.48	2.18	2.21	2.88	2.68	2.18	4.09
24	3.36	4.0	4.66	2.94	2.46	2.3	2.21	2.22	2.76	2.81	2.29	4.07
25	3.3	4.04	5.09	2.9	2.5	2.16	2.2	2.28	2.51	2.74	2.37	3.99
26	3.34	3.96	4.7	2.9	2.51	2.14	2.18	2.55	2.54	2.64	2.31	3.92
27	3.22	3.97	4.38	2.9	2.42	2.18	2.21	2.31	2.32	2.62	2.28	3.91
28	3.18	3.99	4.44	2.86	2.41	2.19	2.2	2.3	2.52	2.56	3.78	3.92
29	3.17	.....	4.83	2.8	2.42	2.15	2.18	2.22	2.59	2.6	4.46	3.68
30	3.21	.....	4.09	2.75	2.34	2.11	2.1	2.26	2.48	2.62	3.95	3.42
31	3.24	.....	3.9	.....	2.28	.....	2.36	2.3	.....	2.6	.....	3.48

NOTE.—January 1 to 6 and January 18 to March 7, river frozen; gage readings to top of ice. Thickness of ice: January 24, 0.2 foot; February 10, 0.9 foot; February 17, 1.25 feet; March 8, 0.9 foot.

Station rating table for South Branch Raritan River at Stanton, N. J., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	37	2.80	174	3.60	462	4.40	847
2.10	46	2.90	201	3.70	506	4.50	900
2.20	57	3.00	231	3.80	551	4.60	954
2.30	70	3.10	264	3.90	597	4.70	1,009
2.40	86	3.20	299	4.00	645	4.80	1,065
2.50	105	3.30	337	4.10	694	4.90	1,122
2.60	126	3.40	377	4.20	744	5.00	1,180
2.70	149	3.50	419	4.30	795		

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1903-1905. It is well defined between gage heights 2.1 feet and 4.4 feet.

Estimated monthly discharge of South Branch Raritan River at Stanton, N. J., for 1905.

[Drainage area, 158 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 7-17	4,210	349	888	5.62	2.30
March 8-31	1,632	337	950	6.01	5.37
April	626	162	290	1.84	2.05
May	159	67	114	.722	.832
June	196	47	73.6	.466	.520
July	80	45	60.0	.380	.438
August	307	50	76.6	.485	.559
September	1,345	65	348	2.20	2.46
October	254	84	140	.886	1.02
November	879	55	136	.861	.961
December	905	84	316	2.00	2.31

NOTE.—River frozen January 1-6 and January 18 to March 7; no estimates made.

NORTH BRANCH OF RARITAN RIVER NEAR PLUCKEMIN, N. J.

This station was established September 9, 1903, by E. P. Roundey. It is located at the second bridge below Far Hills, N. J., on the road to Somerville, about 2 miles from Far Hills.

The channel is straight for 400 feet above and 300 feet below the bridge. A small rift occurs in the channel about 200 feet above the bridge. Both banks are low and liable to overflow. The bed of the stream is composed of gravel.

Discharge measurements are made from the single-span wooden highway bridge on the downstream side. The initial point for soundings is the face of the right abutment at its downstream end.

The original gage was spiked to the upstream wing wall of the right abutment. During 1905 observations have been made by measuring from the bench mark to the water surface with a graduated rod. The observer is Thomas Moore, who records the stage twice each day. The bench mark is a square chiseled on the top of the upstream wing wall of the right abutment. Its elevation is 10.38 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 125, pp 91-92.
Discharge: 82, p 127; 125, p 92.
Gage heights: 125, p 92.

Discharge measurements of North Branch Raritan River near Pluckemin, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 16[a]	F. H. Tillinghast	46	69	1.56	2.30	108
June 21	R. M. Packard	55	146	0.17	1.26	24.6

[a] Measurement taken at bridge near Far Hills railroad station.

Daily gage height, in feet, of North Branch Raritan River near Pluckemin, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.52	2.3	2.9	2.15	1.55	1.45	1.15	1.72	1.7	1.6	1.48	3.6
2	2.4	2.3	2.9	2.1	1.6	1.4	1.15	1.6	2.2	1.6	1.4	3.35
3	2.35	2.3	2.9	2.05	1.5	1.3	1.5	1.45	2.75	1.6	1.4	2.95
4	2.4	2.3	2.9	2.05	1.45	1.27	1.42	1.32	3.4	1.6	1.4	2.25
5	2.4	2.3	2.9	2.55	1.5	1.3	1.32	1.3	2.9	1.52	1.4	1.9
6	2.5	2.35	2.9	2.6	1.45	1.35	1.25	1.3	2.25	1.5	1.4	1.9
7	4.9	2.3	2.8	2.2	1.45	1.7	1.2	1.28	1.75	1.5	1.42	1.9
8	3.25	2.3	2.9	2.2	1.5	1.5	1.18	1.22	1.7	1.5	1.45	1.85
9	3.1	2.3	3.35	2.05	1.45	1.45	1.1	1.2	1.6	1.45	1.5	1.8
10	2.6	2.3	3.05	2.35	1.5	1.45	1.1	1.2	1.6	1.45	1.5	1.75
11	2.7	2.3	2.5	2.1	1.45	1.3	1.1	1.4	2.8	1.5	1.5	1.72
12	2.6	2.6	2.5	2.1	1.5	1.55	1.15	1.4	3.6	2.2	1.5	1.8
13	2.5	3.3	2.15	2.05	1.6	1.45	1.35	1.5	2.9	1.58	1.5	1.8
14	2.5	3.3	2.15	1.95	1.7	1.4	1.22	1.55	2.1	1.52	1.5	1.75
15	2.45	3.3	2.4	2.1	1.5	1.42	1.2	3.15	1.85	1.5	1.5	1.68
16	2.45	3.3	2.1	2.05	1.55	1.35	1.18	2.75	1.8	1.5	1.5	1.62
17	2.45	3.3	2.75	1.95	1.55	1.25	1.2	2.4	1.8	1.45	1.5	1.58
18	2.38	3.3	3.2	1.9	1.55	1.3	1.1	1.95	3.35	1.55	1.5	1.52
19	2.2	3.3	3.9	1.75	1.47	1.25	1.1	1.7	2.8	1.9	1.5	1.5
20	2.2	3.25	3.85	1.8	1.5	1.25	1.65	1.5	2.75	3.02	1.5	1.6
21	2.15	3.15	3.9	1.95	1.4	1.25	1.7	1.25	2.7	1.85	1.5	3.6
22	2.2	3.1	3.75	1.8	1.4	1.35	1.25	1.2	2.7	1.68	1.45	2.2
23	2.3	3.0	3.25	1.75	1.35	1.25	1.5	1.2	2.6	1.6	1.45	2.4
24	2.3	3.0	2.95	1.65	1.35	1.4	1.6	1.2	2.3	1.6	1.4	2.1
25	2.3	2.92	3.55	1.7	1.4	1.25	1.85	1.9	1.95	1.55	1.4	2.0
26	2.3	2.9	3.15	1.55	1.33	1.22	1.65	1.7	1.7	1.68	1.4	1.9
27	2.3	2.9	2.95	1.65	1.27	1.2	1.55	1.5	1.7	1.6	1.4	1.82
28	2.3	2.9	2.6	1.7	1.32	1.15	1.45	1.4	1.6	1.58	1.45	1.8
29	2.3	.....	2.45	1.65	1.25	1.15	2.75	1.3	1.6	1.5	3.95	2.9
30	2.3	.....	2.5	1.6	1.3	1.15	2.3	1.3	1.6	1.45	4.1	2.7
31	2.3	.....	2.3	.....	1.25	.....	1.85	1.3	.....	1.45	.....	2.1

NOTE.—River frozen January 1 to March 10, approximately. Gage read to top of ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 13	3.2	3.3	1.5
February 17	3.2	3.3	1.7
February 18	3.3	3.4	1.85
February 24	2.95	3.1	2.15
March 6	2.8	2.9	2.2

RARITAN RIVER AT FINDERNE, N. J.

This station was established June 27, 1903, by E. P. Roundey. It is located at the highway bridge one-fourth mile from the Central Railroad of New Jersey station at Finderne, N. J.

The channel is straight for 300 feet above and 800 feet below the station. The right bank is low, wooded, and liable to overflow. The left bank will overflow only at extreme high water. The bed of the stream is composed of gravel.

Discharge measurements are made from the upstream side of the two-span highway bridge. The initial point for soundings is the face of the right abutment.

A standard chain gage is located on the downstream side of the right-hand truss on the lower chord. The length of the chain from the end of the weight to the end of the ring is 19.53 feet. The gage is read twice each day by Jacob Siegel. Bench mark No. 1 is a cross chiseled on the coping of the downstream wing wall of the right abutment. Its elevation is 20.11 feet above gage datum. Bench mark No. 2 is the top of the outside connection plate near the zero of the gage scale. Its elevation is 20.14 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 242; 125, pp 87-88.
Discharge: 97, p 242; 125, p 88.
Discharge, monthly: 125, p 89.
Gage heights: 97, p 243; 125, p 88.
Rating table: 125, p 89.

Discharge measurements of Raritan River at Finderne, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 15	F. H. Tillinghast	175	364	3.97	5.08	1,445
June 19	R. M. Packard	117	129	1.42	3.64	182

Daily gage height, in feet, of Raritan River at Finderne, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.48	4.82	5.48	4.68	4.0	3.6	3.48	3.82	3.65	3.9	3.72	4.48
2	6.02	4.9	5.25	4.62	3.98	3.68	3.42	3.72	3.6	3.78	3.7	4.22
3	5.45	4.78	5.42	4.65	3.88	3.75	3.52	3.65	7.32	4.25	3.7	6.0
4	5.08	4.82	5.42	4.52	3.88	3.45	3.55	3.55	8.38	4.38	3.72	4.72
5	4.6	4.9	5.05	5.12	4.22	3.6	3.58	3.52	7.55	3.85	3.75	4.3
6	4.4	4.98	5.12	6.15	3.85	3.6	3.5	3.48	4.7	3.88	3.7	4.22
7	14.03	5.25	5.3	5.0	3.85	3.58	3.55	3.58	4.45	3.82	3.72	4.15
8	7.45	5.25	4.78	4.8	3.88	3.7	3.52	3.48	4.25	3.88	3.75	4.15
9	5.58	4.95	10.33	4.6	3.78	3.75	3.5	3.58	4.3	3.82	3.72	4.2
10	5.05	4.88	11.75	4.5	3.72	3.65	3.5	3.48	4.0	3.92	3.8	4.2
11	4.85	4.95	8.55	4.55	3.65	3.58	3.55	3.5	3.98	3.88	3.65	4.3
12	5.9	4.8	6.5	4.58	3.82	3.65	3.42	3.55	7.88	4.25	3.65	4.2
13	5.05	5.55	5.62	4.45	3.75	4.02	3.55	4.08	4.3	3.98	3.65	4.5
14	4.7	5.45	5.72	4.4	3.9	3.8	3.48	3.62	4.65	3.98	3.65	4.1
15	4.5	5.2	5.3	4.45	3.98	3.7	3.55	4.95	4.38	3.92	3.7	4.0
16	4.25	4.85	5.5	4.3	4.0	3.65	3.42	9.62	4.28	3.85	3.6	4.25
17	4.38	5.1	5.95	4.18	3.95	3.6	3.48	4.58	4.12	3.9	3.65	4.3
18	4.3	5.3	5.62	4.18	3.98	3.55	3.42	4.15	4.1	3.85	3.6	4.0
19	4.38	4.95	7.85	4.2	3.9	3.65	3.48	3.98	5.32	3.92	3.62	3.98
20	4.35	4.95	7.22	4.15	3.82	3.52	3.38	3.75	4.25	4.98	3.58	3.98
21	4.37	5.05	9.05	4.18	3.7	3.55	3.38	3.72	4.68	4.65	3.5	7.55
22	4.08	5.12	7.4	4.42	3.8	3.65	3.35	3.68	4.32	4.28	3.62	5.42
23	4.35	5.23	5.88	4.2	3.75	4.0	3.42	3.62	4.22	4.0	3.62	5.32
24	4.2	5.05	5.68	4.18	3.75	3.7	3.48	3.6	4.3	4.0	3.52	4.78
25	4.15	5.32	7.1	4.15	3.62	3.58	3.5	3.58	4.1	3.98	3.58	4.52
26	5.1	5.45	6.0	4.1	3.68	3.52	3.42	4.4	4.0	3.98	3.48	4.38
27	5.22	5.62	5.9	4.08	3.68	3.48	3.42	3.75	3.92	3.98	3.45	4.3
28	5.48	5.75	5.5	4.3	3.6	3.52	3.42	3.68	4.0	3.95	3.52	4.28
29	5.32	.....	5.18	4.0	3.7	3.45	3.52	3.75	3.88	3.92	6.22	5.6
30	5.5	.....	4.98	4.12	3.68	3.55	4.28	3.68	3.88	3.9	6.32	4.95
31	4.85	.....	4.9	.....	3.62	.....	3.9	3.78	.....	3.9	.....	4.6

NOTE. River frozen over January 26 to March 15, approximately. Gage was read to water surface in a hole cut in the ice. Thickness of ice, 0.5 foot.

Station rating table for Raritan River at Finderne, N. J., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	75	4.40	695	5.50	1,785	7.00	3,565
3.40	105	4.50	783	5.60	1,895	7.20	3,815
3.50	140	4.60	875	5.70	2,005	7.40	4,065
3.60	180	4.70	969	5.80	2,120	7.60	4,325
3.70	225	4.80	1,064	5.90	2,235	7.80	4,585
3.80	275	4.90	1,159	6.00	2,350	8.00	4,845
3.90	330	5.00	1,255	6.20	2,585	8.50	5,515
4.00	393	5.10	1,355	6.40	2,825	9.00	6,210
4.10	461	5.20	1,460	6.60	3,065	9.50	6,950
4.20	534	5.30	1,565	6.80	3,315	10.00	7,730
4.30	612	5.40	1,675				

The above table is applicable only for open channel conditions. It is based on thirteen discharge measurements made during 1903–1905. It is fairly well defined between gage heights 3.9 feet and 10.5 feet. The table has been extended beyond these limits. Above gage height 10 feet the rating curve is a tangent, the difference being 170 per tenth.

Above 4 feet the table is the same as for 1904.

Estimated monthly discharge of Raritan River at Finderne, N. J., for 1905.

[Drainage area, 490 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 1–25	14,580	447	1,722	3.51	3.27
March 16–31	6,280	1,159	2,682	5.47	3.25
April	2,525	393	772	1.58	1.76
May	629	180	293	.598	.689
June	407	123	201	.410	.457
July	596	90	153	.312	.360
August	7,130	133	513	1.05	1.21
September	5,353	180	1,024	2.09	2.33
October	1,236	265	420	.857	.988
November	2,729	122	364	.743	.829
December	4,335	380	914	1.87	2.16

NOTE.—River frozen January 26 to March 15; no estimates made.

RARITAN RIVER AT BOUND BROOK, N. J.

This station was established September 12, 1903, by E. P. Roundey. It is located at the highway bridge just back of the Lehigh Valley Railroad station at Bound Brook, N. J.

The channel is straight for 500 feet above and below the station. Both banks are high, subject to overflow only at very high stages, and are without trees. The bed of the stream is composed of gravel.

Discharge measurements are made from the upstream side of the three-span highway bridge. The initial point for soundings is the face of the right abutment.

The original staff gage fastened to the upstream wing wall of the right abutment was carried away by the ice January 23, 1904. February 2, 1904, a standard chain gage was fastened to the upstream side of the bridge 240 feet from the right abutment. The length of the chain from the end of the weight to the marker is 23.44 feet. The gage is read twice each day by Joseph K. Tantum. Bench mark No. 1 is a square chiseled on the upstream wing wall of the right abutment. Its elevation is 19.45 feet above gage datum. Bench

mark No. 2 is the top of the rail 2 feet beyond the pulley end of the gage. Its elevation is 23.77 feet above gage datum. Bench mark No. 3 is a point on the guard rail of the bridge 225 feet from the initial point for soundings. Its elevation is 20.75 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 239; 125, p 90.
Discharge: 82, p 127; 97, p 240; 125, p 90.
Gage heights: 97, p 240; 125, p 91.

Discharge measurements of Raritan River at Bound Brook, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 15	F. H. Tillinghast	380	1,465	1.80	2.83	2,639
March 17	do	380	1,469	1.83	2.89	2,684
June 19	R. H. Bolster	352	817	.39	1.05	315

Daily gage height, in feet, of Raritan River at Bound Brook, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	1.8	2.2	2.15	1.45	1.2	1.05	1.3	1.2	1.2	1.2	1.9
2	3.15	1.8	2.2	2.0	1.4	1.2	1.05	1.25	1.2	1.2	1.2	1.7
3	2.95	1.8	2.2	1.9	1.4	1.2	1.1	1.2	5.07	1.3	1.2	2.3
4	2.35	1.7	2.25	1.85	1.4	1.2	1.15	1.15	5.8	1.3	1.2	2.75
5	2.1	1.8	2.1	2.85	1.4	1.2	1.15	1.1	3.25	1.2	1.2	1.95
6	2.35	1.9	2.0	3.8	1.4	1.2	1.15	1.1	2.4	1.2	1.2	1.8
7	10.3	1.9	2.25	2.9	1.4	1.2	1.1	1.05	2.0	1.2	1.2	1.65
8	5.7	2.0	2.1	2.5	1.3	1.3	1.1	1.1	1.8	1.2	1.2	1.6
9	3.5	2.0	6.0	2.15	1.3	1.3	1.1	1.25	1.65	1.2	1.2	1.55
10	2.65	1.95	7.4	2.0	1.3	1.2	1.05	1.15	1.45	1.2	1.2	1.7
11	2.35	1.85	5.7	2.15	1.25	1.2	1.05	1.15	1.4	1.2	1.2	1.7
12	3.1	1.8	4.2	2.15	1.3	1.2	1.0	1.1	4.67	1.45	1.2	1.6
13	3.2	2.1	3.4	2.0	1.3	1.25	1.05	1.1	2.25	1.4	1.15	1.5
14	2.3	2.8	3.05	1.9	1.3	1.25	1.05	1.5	1.85	1.2	1.1	1.5
15	2.3	2.6	2.9	1.9	1.35	1.2	1.05	2.3	1.65	1.2	1.1	1.35
16	3.3	2.4	2.9	1.85	1.4	1.2	1.05	6.2	1.6	1.2	1.15	1.4
17	3.0	2.3	3.2	1.65	1.4	1.2	1.05	2.3	1.5	1.2	1.15	1.45
18	2.85	2.0	3.3	1.6	1.55	1.2	1.0	1.75	1.6	1.2	1.15	1.35
19	2.3	1.8	4.7	1.65	1.5	1.1	1.05	1.6	2.05	1.2	1.15	1.4
20	1.8	1.8	4.65	1.6	1.4	1.3	1.05	1.4	1.75	2.15	1.1	1.4
21	1.8	1.8	5.9	1.6	1.35	1.15	.95	1.3	1.85	2.15	1.1	3.75
22	1.7	1.8	5.45	1.65	1.25	1.15	.95	1.25	1.6	1.65	1.1	3.3
23	1.7	1.8	3.8	1.55	1.3	1.35	.95	1.2	1.55	1.5	1.15	2.6
24	1.5	1.8	3.15	1.5	1.25	1.25	.95	1.15	1.4	1.4	1.15	2.45
25	1.2	1.9	4.0	1.5	1.2	1.2	1.0	1.4	1.35	1.4	1.1	2.05
26	1.2	2.1	3.5	1.5	1.2	1.2	1.05	1.6	1.35	1.4	1.15	1.85
27	1.2	2.45	3.15	1.5	1.2	1.1	1.05	1.2	1.3	1.4	1.15	1.8
28	1.25	2.35	2.95	1.6	1.2	1.1	.95	1.25	1.25	1.3	1.2	1.7
29	1.8	.....	2.7	1.6	1.2	1.05	1.0	1.2	1.25	1.3	2.85	2.95
30	1.8	.....	2.35	1.5	1.2	1.05	1.85	1.25	1.2	1.3	3.6	2.6
31	1.8	.....	2.3	.....	1.2	.....	1.5	1.15	.....	1.2	.....	2.05

NOTE.—River frozen over January 16–21 and January 26 to March 9. Thickness of ice, 0.4 to 0.7 foot. During frozen period gage was read to top of ice.

Station rating table for Raritan River at Bound Brook, N. J., from September 12, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	205	2.00	1,300	3.20	3,240	5.40	7,980
1.00	275	2.10	1,440	3.40	3,610	5.60	8,480
1.10	350	2.20	1,580	3.60	4,000	5.80	8,980
1.20	430	2.30	1,730	3.80	4,400	6.00	9,500
1.30	520	2.40	1,890	4.00	4,800	6.20	10,030
1.40	615	2.50	2,050	4.20	5,220	6.40	10,570
1.50	715	2.60	2,210	4.40	5,660	6.60	11,120
1.60	820	2.70	2,370	4.60	6,100	6.80	11,680
1.70	930	2.80	2,540	4.80	6,560	7.00	12,250
1.80	1,050	2.90	2,710	5.00	7,020	7.50	13,700
1.90	1,170	3.00	2,880	5.20	7,500	8.00	15,200

The above table is applicable only for open-channel conditions. It is based on eleven discharge measurements made during 1903–1905 between gage heights 1.05 feet and 7.35 feet. Measurements at this station do not plot well, owing to slight shifting of the stream bed and influence of backwater from a dam 2 miles below. Estimates are therefore subject to considerable error, particularly in times of low water.

Estimated monthly discharge of Raritan River at Bound Brook, N. J., for 1903–1905.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September 12–30	5,880	665	1,544	1.93	1.36
October	28,500	615	3,152	3.94	4.54
November	1,370	615	757	.946	1.06
December 1–9, 20–26	10,570	520	1,800	2.25	1.34
1904.					
February 8–9, 22–29	19,820	1,370	5,191	6.49	2.41
March	17,060	820	2,204	2.76	3.18
April 1–28	7,740	615	1,617	2.02	2.10
May 8–31	875	430	566	.708	.632
June	1,300	350	651	.814	.908
July	2,130	430	758	.948	1.09
August	6,330	615	1,860	2.32	2.68
September	21,940	520	1,830	2.29	2.56
October	10,440	520	1,604	2.00	2.31
November	5,330	665	1,122	1.40	1.56
December 1–9, 28–31	4,600	568	1,581	1.98	.957
1905.					
January 1–15, 22–25	22,620	430	3,451	4.31	3.04
March 10–31	13,410	1,730	4,723	5.90	4.83
April	4,400	715	1,284	1.60	1.78
May	768	430	545	.681	.785
June	568	312	430	.538	.600
July	1,110	240	347	.434	.500
August	10,030	312	878	1.10	1.27
September	8,980	430	1,640	2.05	2.29
October	1,510	430	575	.719	.829
November	4,000	350	594	.782	.872
December	4,300	568	1,336	1.67	1.92

NOTE.—River frozen December 10–19, 27–31, 1903; January 1–22, February 2–7, 10–21, December 10–27, 1904; January 16–21, January 26 to March 9, 1905; no estimates made. No record of gage heights January 24 to February 1 and April 29 to May 7, 1904.

DELAWARE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Delaware River rises in Delaware, Greene, and Schoharie counties, N. Y., the source of the main stream, which is commonly known as West Branch, to distinguish it from the smaller East or Pepacton Branch, being a small lake almost on the line of Schoharie and Delaware counties, at an elevation of 1,886 feet above tide. From this lake it flows southwestward across central Delaware County to Deposit, where it receives Oquaga Creek, a large tributary draining eastern Broome County, and turns abruptly to the southeast, forming the boundary line between New York and Pennsylvania until Port Jervis is reached. Here it turns again to the southwest and flows for a distance of about 40 miles along the base of the Shawangunk Range until it passes through the water gap, from which point it flows irregularly southward to Trenton. Below Trenton the course is in general southwestward to Delaware Bay. South of Port Jervis it forms the dividing line between Pennsylvania and New Jersey, and for a few miles between Delaware and New Jersey.

East Branch rises at Grand Gorge in northeastern Delaware county, and flows parallel to West Branch across southern Delaware County, uniting with the latter stream at Hancock.

The total length of the river from the mouth to the head of West Branch is about 410 miles; its drainage area, measured at Philadelphia and including Schuylkill River is 10,100 square miles, of which about 2,580 square miles lie in New York, 5,720 in Pennsylvania, and 1,800 in New Jersey. The river is tidal to Trenton, which lies also at the head of navigation.

The upper drainage area is relatively long and narrow, with numerous short, lateral tributaries. From its head streams in New York it flows in a tortuous course through a deep, narrow trough in an elevated table land, the mean level of the plateau remaining nearly constant, the valley growing progressively deeper, and the river hills becoming higher and steeper. On leaving the plateau in Wayne and Pike counties, Pa., the river emerges into a broad, open valley, bordered on the west by fertile cultivated flats, behind which rise numerous rolling hills, and on the east by the forest-covered flanks of the Kittatinny Mountains. Passing through the mountains by means of the celebrated water gap, it descends obliquely southward across the entire Appalachian Valley to the point where it enters the South Mountains below Easton. The topography of this portion of its course is marked by no striking features, the surface of the country being elevated only 100 or 200 feet above the stream. Between Easton and Trenton the river is bordered by an alternation of hills and narrow intervening valleys, while below Trenton it becomes a wide, tidal stream flowing between shores which are in many places only low banks of sand or gravel and in others broad, slimy marshes covered with reeds and grass.

The fall of the river is rapid; the bed is principally gravel, sand, and bowlders, and at many places rock, and the banks are generally high. The flow is extremely variable, and would no doubt be much more so were it not for the great number of lakes which are tributary to the stream from northern Pennsylvania and New Jersey as well as from New York. The influence of these lakes in moderating floods must be considerable.

The Delaware receives a number of important tributaries, among which may be mentioned Mongaup and Neversink rivers and Callicoon creek from New York; Lackawaxen, Lehigh, and Schuylkill rivers and numerous creeks from Pennsylvania, and Rancocas Creek, Musconetcong River, and Maurice River from New Jersey.

Measurements of the flow of Delaware River were made during the last half of June, 1891, by Prof. Dwight Porter and students at Delaware Watergap, Pa. The results show a flow from 2,000 to 2,200 second-feet. This was said to be the lowest June stage for five years. Measurements were made during the drought of 1895 by Prof. L. M. Haupt at Point Pleasant, Pa., near the intake of the Delaware and Raritan Canal feeder. The discharge above the bridge was 1,657 second-feet and below the bridge 1,328 second-feet. The discharge was measured by E. G. Paul June 4, 1899, at Martins Creek, Pa., 7 miles above the mouth of Lehigh River, and found to be 2,724 second-feet.

During 1905 the following gaging stations were maintained in the Delaware River basin by the United States Geological Survey:

West Branch Delaware River at Hancock, N. Y.
East Branch Delaware River at Hancock, N. Y.
Delaware River at Lambertville, N. J.
Musconetcong River near Bloomsbury, N. J.

In addition to the work at these stations measurements have been made for several years by Mr. John E. Codman, hydrographer of the water department of the city of Philadelphia, on the following streams in the vicinity of Philadelphia: Perkiomen, Tohickon, Neshaminy, and Wissahickon creeks, and Schuylkill River.

WEST BRANCH DELAWARE RIVER AT HANCOCK, N. Y.

This station was established October 15, 1902, by P. M. Churchill, It is located one-half mile west of the Erie Railroad station at Hancock, N. Y., and about 1 mile above the mouth of East Branch.

The channel is straight for 400 feet above and 800 feet below the bridge. The current is swift. Both banks are high and rocky and are not subject to overflow. The bed of the stream is composed of earth and cobblestones.

Discharge measurements are made from the downstream side of the bridge, at which the gage is located. The bridge has a single span of 235 feet. The initial point for soundings is the top of the face of the left abutment on the downstream side. The bridge floor is marked at intervals of 5 feet with black paint.

The original wire gage was attached to the upstream side of the bridge. It was replaced July 20, 1903, by a standard chain gage. The location and the gage datum were not changed. The length of the chain from the end of the weight to the marker is 30.44 feet. The gage is read twice each day by David Pulver, the collector of tolls at the bridge. The bench mark is a circular chisel draft on the upstream corner of the left abutment. Its elevation is 24.25 feet above gage datum. The elevation of the top of the pulley is 30.54 feet above gage datum.

Information in regard to this station is contained in the annual reports of the state engineer and surveyor of New York prior to 1905 and in the following Water-Supply Papers of of the United States Geological Survey:

Description: 82, p. 128; 97, p. 262; 125, p. 96.
Discharge: 82, p. 128; 97, p. 263; 125, p. 96.
Gage heights: 82, p. 129; 97, p. 263; 125, p. 97.

Discharge measurements of West Branch Delaware River at Hancock, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 22	Beebe and Swancott	245	1,130	4.89	6.38	5,525
March 23	do	245	1,025	5.08	5.92	5,211
March 24	do	253	937	4.29	5.55	4,022
March 25	do	300	1,633	6.96	8.05	11,380
March 26	do	295	1,689	5.42	7.45	9,165
August 18	Covert and Weeks	222	543	1.42	3.90	774

Daily gage height, in feet, of West Branch Delaware River at Hancock, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.65	4.49	3.65	5.85	3.5	3.0	3.15	3.6	4.22	3.4	3.6	5.0
2	4.5	4.29	3.75	5.25	3.45	2.95	3.35	3.7	3.8	3.4	3.5	4.7
3	4.35	4.09	3.85	4.9	3.5	2.9	4.3	3.28	4.0	3.32	3.4	7.2
4	3.95	4.09	3.7	4.9	3.5	2.95	3.65	3.15	4.65	3.75	3.4	7.8
5	3.65	4.04	3.8	4.95	3.35	3.15	3.4	3.15	4.75	3.45	3.4	6.15
6	4.1	4.09	3.75	5.1	3.45	4.2	3.3	3.0	4.35	3.35	3.45	5.55
7	6.95	3.79	3.7	5.05	3.65	4.0	3.3	3.1	4.3	3.22	4.0	5.15
8	6.45	3.53	3.95	5.0	3.6	3.85	3.4	3.45	3.95	3.2	4.0	4.85
9	5.2	3.28	3.95	4.7	3.3	3.85	3.35	3.15	3.95	3.18	3.9	4.6
10	4.8	3.43	4.2	4.9	3.35	3.6	3.3	3.1	3.72	3.18	3.9	4.4
11	4.4	3.38	3.85	5.0	3.3	3.45	3.3	3.2	3.62	3.1	3.8	4.3
12	4.6	3.58	3.95	5.3	3.4	3.65	3.15	3.2	4.48	4.6	3.75	4.2
13	5.6	3.88	3.85	5.05	3.5	3.45	3.0	3.85	4.25	4.52	3.7	4.05
14	4.6	3.53	3.8	4.7	3.5	3.45	3.05	3.35	3.95	4.05	3.6	3.9
15	3.99	3.43	3.8	4.55	3.7	3.35	3.0	3.4	3.8	3.8	3.55	3.65
16	3.84	3.52	3.85	4.5	3.55	3.3	3.05	4.05	3.8	3.75	3.52	3.45
17	3.94	4.0	3.95	4.35	3.6	3.22	3.1	4.15	3.8	3.65	3.5	3.95
18	3.89	3.9	4.2	4.2	3.6	3.05	3.1	3.8	4.4	3.6	3.48	4.75
19	4.09	4.2	8.6	4.15	3.65	3.35	3.0	3.5	4.9	3.7	3.4	4.25
20	3.84	4.0	8.0	4.05	3.4	3.35	3.2	3.4	4.7	4.3	3.35	3.95
21	3.59	4.2	7.25	4.3	3.45	3.25	3.05	3.35	5.8	4.25	3.25	4.2
22	3.54	3.9	6.55	4.35	3.35	4.1	3.0	3.3	5.05	4.1	3.2	4.65
23	4.34	4.0	6.05	4.15	3.4	4.0	3.1	3.15	4.7	3.95	3.3	4.25
24	3.54	3.95	5.6	4.0	3.35	3.85	3.05	3.15	4.45	3.9	3.2	3.9
25	3.94	4.05	7.22	3.95	3.3	3.7	3.05	3.15	4.25	3.9	3.3	3.75
26	4.84	4.05	7.5	3.95	3.25	3.35	3.0	3.1	4.0	3.75	3.15	3.75
27	4.94	4.0	8.0	3.9	3.35	3.25	2.9	3.1	3.85	3.65	3.15	3.6
28	4.94	3.95	7.55	3.9	3.5	3.2	3.0	2.98	3.7	3.7	2.98	3.6
29	4.74	.....	7.0	3.6	3.3	3.35	2.9	3.05	3.6	3.55	4.6	3.85
30	4.69	.....	6.9	3.7	3.15	3.25	2.95	3.3	3.55	3.55	6.18	4.05
31	4.59	.....	6.65	.....	3.1	.....	3.3	4.28	.....	3.45	.....	3.85

NOTE.—Ice conditions February 1 to March 18, approximately.

Station rating table for West Branch Delaware River at Hancock, N. Y., from October 15, 1902, to October 10, 1903.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	20	3.00	814	5.20	3,246	7.60	9,880
2.10	27	3.70	900	5.30	3,465	7.80	10,520
2.20	40	3.80	992	5.40	3,690	8.00	11,200
2.30	58	3.90	1,091	5.50	3,920	8.20	11,880
2.40	85	4.00	1,198	5.60	4,155	8.40	12,560
2.50	120	4.10	1,315	5.70	4,395	8.60	13,240
2.60	161	4.20	1,443	5.80	4,640	8.80	13,960
2.70	208	4.30	1,583	5.90	4,890	9.00	14,680
2.80	260	4.40	1,734	6.00	5,150	9.50	16,560
2.90	317	4.50	1,895	6.20	5,690	10.00	18,520
3.00	378	4.60	2,065	6.40	6,250	10.50	20,520
3.10	443	4.70	2,244	6.60	6,820	11.00	22,600
3.20	511	4.80	2,431	6.80	7,400	11.50	24,780
3.30	582	4.90	2,625	7.00	8,000	12.00	27,000
3.40	656	5.00	2,826	7.20	8,600	13.00	31,600
3.50	733	5.10	3,033	7.40	9,240		

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1902-3. It is fairly well defined between gage heights 2.5 feet and 6 feet. The table has been extended beyond these limits.

Station rating table for West Branch Delaware River at Hancock, N. Y., from October 11, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	50	3.60	523	4.50	1,680	5.40	3,610
2.80	79	3.70	614	4.60	1,859	5.50	3,860
2.90	113	3.80	714	4.70	2,047	5.60	4,110
3.00	152	3.90	822	4.80	2,245	5.70	4,370
3.10	196	4.00	939	4.90	2,453	5.80	4,630
3.20	245	4.10	1,066	5.00	2,670	5.90	4,890
3.30	300	4.20	1,204	5.10	2,896	6.00	5,150
3.40	365	4.30	1,352	5.20	3,130		
3.50	440	4.40	1,511	5.30	3,370		

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1904-5. It is fairly well defined between gage heights 3 feet and 8 feet. The table has been extended beyond these limits, being the same as the preceding table above 6 feet.

Estimated monthly discharge of West Branch Delaware River at Hancock, N. Y., for 1902–1905.

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
1902.				**1904.**			
October 15–31	8,090	378	1,812	July	1,680	129	410
November	1,980	184	622	August	3,860	440	1,247
December	12,662	366	2,439	September	2,670	196	761
1903.				October	9,560	332	1,582
March 16–31	12,560	1,341	3,471	November	1,680	300	669
April	2,726	378	1,170	December 1–9, 28–31	8,920	300	1,696
May	208	37	119				
June	3,421	21	782	**1905.**			
July	1,256	92	381	January	7,850	473	1,899
August	9,368	184	1,100	March 19–31	13,240	4,110	8,544
September	2,509	109	604	April	4,760	523	1,894
October	33,740	136	3,492	May	614	196	396
November	5,582	187	1,013	June	1,204	113	454
December	7,460	418	2,431	July	1,352	113	270
1904.				August	1,322	144	397
March 7–31	31,830	2,760	10,803	September	4,630	482	1,344
April	6,791	857	2,666	October	1,859	196	652
May	2,627	346	1,013	November	5,636	144	681
June	1,528	53	420	December	10,520	402	2,026

NOTE.—No estimates during frozen period.

EAST BRANCH DELAWARE RIVER AT HANCOCK, N. Y.

This station was established October 14, 1902, by P. M. Churchill. It is located at the highway bridge one-half mile southeast of the Erie Railroad station at Hancock, N. Y., and 1 mile above the junction with West Branch of the Delaware. The Erie Railroad bridge is just below the station.

The channel is straight for 600 feet above and 300 feet below the station. The current is swift. Both banks are of medium height and are not liable to overflow. The bed of the stream is composed of rocks and gravel. There are three channels at low water and five channels at high water. During low water the elevation of the water surface at the station is lower than the water surface on West Branch of the Delaware, but there is no danger of the gage heights being affected by backwater from West Branch, as there is considerable fall between the gaging station and the junction of the branches.

Discharge measurements are made from the downstream side of the five-span iron highway bridge to which the gage is attached. The bridge has a total span of 425.5 feet between abutments. The initial point for soundings is the face of the right abutment at the top.

A standard chain gage is attached to the lower chord of the second span from the left end of the bridge on the upstream side. It was installed July 21, 1903, to replace the old wire gage. The gage datum was not changed. The length of the chain from the end of the weight to the marker is 32.43 feet. The gage is read twice each day by D. B. Van Etten. The bench mark is a circular chisel draft on the top of the left abutment on the downstream side. It is marked "B. M." Its elevation is 27.93 feet above gage datum. The elevation of the top of the gage pully is 32.40 feet above gage datum.

Information in regard to this station is contained in the annual reports of the State engineer and surveyor of New York prior to 1905, and in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, pp 129–130; 97, p 264; 125, p 98.
Discharge: 82, p 129; 97, p 265; 125, p 98.
Gage heights: 82, p 130; 97, p 265; 125, p 99.

Discharge measurements of East Branch Delaware River at Hancock, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 22	Beebe and Swancott	351	1,568	4.38	6.18	6,863
March 23	do	337	1,420	4.62	5.85	6,554
March 24	do	336	1,309	3.85	5.42	5,046
March 25	do	352	2,028	6.04	7.59	12,260
March 26	do	352	1,879	5.57	7.00	10,470
August 16	C. C. Covert	321	660	1.26	3.45	829
August 18	Covert and Weeks	318	643	1.23	3.40	791

Daily gage height, in feet, of East Branch Delaware River at Hancock, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	4.9	4.35	6.85	3.62	3.45	2.8	3.52	3.9	3.32	3.42	5.05
2	4.5	4.8	4.2	5.95	3.55	2.95	3.0	3.35	3.58	3.28	3.4	4.8
3	4.95	4.65	4.2	5.4	3.5	3.02	3.88	3.15	4.7	3.35	3.3	7.05
4	4.35	4.65	4.2	5.12	3.48	2.98	3.48	3.08	5.0	3.45	3.32	8.8
5	4.05	4.45	4.15	5.18	3.4	2.9	3.22	3.0	5.1	3.28	3.3	6.2
6	4.22	4.55	4.15	5.45	3.4	3.25	3.1	2.92	4.55	3.2	3.35	5.3
7	6.5	4.5	4.15	5.45	3.5	3.72	3.08	2.9	4.25	3.12	3.8	5.05
8	7.0	4.58	4.25	5.1	3.48	3.52	3.02	2.9	4.05	3.1	3.7	4.75
9	5.55	4.52	4.35	4.85	3.35	3.42	2.98	2.88	3.85	3.05	3.7	4.55
10	5.1	4.6	4.6	4.68	3.32	3.28	2.9	2.8	3.72	3.02	3.6	4.35
11	4.7	4.6	4.7	4.7	3.28	3.22	2.9	2.8	3.6	3.5	3.55	4.15
12	4.7	4.55	4.65	5.0	3.3	3.2	2.88	2.95	4.6	4.48	3.52	4.08
13	5.7	4.5	4.55	4.8	3.38	3.48	3.0	3.2	4.5	4.22	3.5	3.95
14	4.8	4.5	4.45	4.62	3.35	3.42	3.05	3.05	4.1	3.85	3.48	3.82
15	4.2	4.45	4.35	4.52	3.32	3.25	3.15	3.05	3.85	3.7	3.38	3.6
16	4.25	4.5	4.35	4.45	3.32	3.12	3.05	3.4	3.7	3.6	3.38	3.55
17	4.3	4.45	4.35	4.32	3.32	3.1	2.92	3.65	3.68	3.5	3.38	3.6
18	4.32	4.5	4.3	4.2	3.32	3.0	2.85	3.4	3.65	3.48	3.32	3.5
19	4.22	4.4	6.05	4.08	3.35	3.1	2.8	3.2	4.2	3.52	3.3	3.65
20	4.05	4.4	8.0	4.0	3.32	3.1	3.1	3.1	4.05	4.0	3.28	3.5
21	3.98	4.38	6.7	4.2	3.25	3.08	3.05	3.05	5.05	4.1	3.2	3.55
22	3.88	4.4	6.25	4.2	3.2	3.15	2.92	3.0	4.52	4.08	3.2	4.35
23	3.52	4.3	5.9	4.05	3.2	3.2	2.88	2.95	4.25	3.98	3.22	3.95
24	3.4	4.32	5.4	3.92	3.18	3.08	2.8	2.9	4.05	3.9	3.12	3.82
25	3.82	4.38	7.92	3.9	3.12	2.95	2.95	2.9	3.85	3.85	3.15	3.68
26	4.25	4.4	7.35	3.8	3.1	2.9	3.05	3.02	3.75	3.75	3.15	3.6
27	4.7	4.3	8.2	3.8	3.1	2.9	2.92	2.92	3.62	3.65	3.1	3.7
28	5.15	4.3	8.05	3.72	3.1	2.9	2.82	2.85	3.58	3.55	3.1	3.62
29	5.1	.....	7.9	3.65	3.05	2.85	2.8	2.82	3.48	3.52	4.1	3.65
30	5.1	.....	8.4	3.75	3.0	2.8	3.15	3.1	3.4	3.48	6.65	3.82
31	4.95	.....	7.85	.....	3.0	.....	3.55	4.5	.....	3.42	.....	3.62

NOTE.—River frozen entirely across February 1 to March 18, approximately. There was a large quantity of needle ice. During this period the gage was read to water surface in a hole cut in the ice. The following comparative readings were also made:

Daily gage height, in feet, of East Branch Delaware River at Hancock, N. Y., for 1905—Con.

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 4	4.7	4.85	0.9
February 11	4.6	4.4	1.0
February 18	4.5	4.4	1.1
February 25	4.4	4.3	1.0
March 4	4.2	4.5	1.2
March 11	4.7	4.6	1.3
March 18	4.3	4.4	1.3

Station rating table for East Branch Delaware River at Hancock, N. Y., from October 14, 1902, to October 10, 1903.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	190	4.30	2,265	6.20	7,330	9.80	22,880
2.60	230	4.40	2,453	6.40	8,020	10.00	23,960
2.70	280	4.50	2,650	6.60	8,730	10.50	26,700
2.80	340	4.60	2,857	6.80	9,460	11.00	29,520
2.90	410	4.70	3,075	7.00	10,210	11.50	32,440
3.00	490	4.80	3,304	7.20	10,980	12.00	35,460
3.10	580	4.90	3,544	7.40	11,760	12.50	38,600
3.20	679	5.00	3,795	7.60	12,560	13.00	41,880
3.30	787	5.10	4,055	7.80	13,360	13.50	45,280
3.40	903	5.20	4,320	8.00	14,200	14.00	48,780
3.50	1,027	5.30	4,590	8.20	15,040	14.50	52,400
3.60	1,159	5.40	4,865	8.40	15,920	15.00	56,120
3.70	1,298	5.50	5,150	8.60	16,820	15.50	59,960
3.80	1,443	5.60	5,440	8.80	17,760	16.00	63,900
3.90	1,594	5.70	5,735	9.00	18,740	16.50	67,960
4.00	1,751	5.80	6,035	9.20	19,740	17.00	72,140
4.10	1,915	5.90	6,345	9.40	20,780	17.50	76,440
4.20	2,086	6.00	6,665	9.60	21,820		

The above table is applicable only for open-channel conditions. It is based upon nine discharge measurements made during 1902–3. It is fairly well defined between gage heights 2.7 feet and 6 feet. The table has been extended beyond these limits.

Station rating table for East Branch Delaware River at Hancock N. Y., from October 11, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	120	3.50	924	4.50	2,752	5.50	5,285
2.60	151	3.60	1,054	4.60	2,984	5.60	5,565
2.70	195	3.70	1,196	4.70	3,222	5.70	5,850
2.80	252	3.80	1,351	4.80	3,464	5.80	6,140
2.90	322	3.90	1,519	4.90	3,710	5.90	6,435
3.00	402	4.00	1,700	5.00	3,960	6.00	6,735
3.10	492	4.10	1,892	5.10	4,215	6.20	7,365
3.20	589	4.20	2,094	5.20	4,475	6.40	8,025
3.30	693	4.30	2,306	5.30	4,740	6.60	8,730
3.40	804	4.40	2,526	5.40	5,010		

The above table is applicable only for open-channel conditions. It is based upon nine discharge measurements made during 1904–5. It is well defined between gage heights 3 feet and 7.5 feet. Above gage height 6.5 feet the table is the same as the preceding one.

Estimated monthly discharge of East Branch Delaware River at Hancock, N. Y., for 1902.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
October 15–31	10,400	903	2,821
November	3,424	679	1,270
December	23,960	903	5,093

Estimated monthly discharge of East Branch Delaware River at Hancock, N. Y., for 1903.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
March 16–31	20,210	2,733	6,010
April	6,601	744	2,434
May	679	270	416
June	10,670	198	2,252
July	4,055	403	909
August	10,750	490	1,817
September	3,520	368	962
October	50,510	334	5,724
November	9,571	782	2,205
December	12,440	1,320	2,914

No estimate for frozen period.

Estimated monthly discharge of East Branch Delaware River at Hancock, N. Y., for 1904.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
March 22–31	72,480	4,449	33,320
April	11,680	1,892	5,162
May	4,554	793	1,677
June	2,054	308	848
July	6,615	322	897
August	3,222	589	1,305
September	1,435	322	656
October	19,240	589	2,842
November	4,215	748	1,329
December	10,590	1,274	3,064

No estimate for frozen period.

Estimated monthly discharge of East Branch Delaware River at Hancock, N. Y., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January	10,210	804	3,261
March 19–31	15,920	5,010	11,330
April	9,645	1,125	3,123
May	1,082	402	698
June	1,227	252	555
July	1,485	252	455
August	2,752	252	548
September	4,215	804	1,946
October	2,707	420	1,112
November	8,910	492	1,088
December	17,760	924	2,837

No estimate for frozen period.

DELAWARE RIVER AT LAMBERTVILLE, N. J.

This station was established July 22, 1897, by Arthur P. Davis. It is located at the toll bridge at Lambertville, N. J.

The channel is straight above and below the station. The bed of the stream is of gravel and sand and does not change. A dam located about a mile below the station may change slowly and thus in time affect the stage of water at the station.

Discharge measurements are made from the lower side of the bridge to which the gage is attached. The initial point for soundings is on the left bank.

The original gage was a standard chain gage attached to the covered toll bridge. The datum of this gage was 2.00 feet below that of the United States Weather Bureau gage painted on the first bridge pier, and was referred to a copper bolt set in the sill of the extreme south door on the east side of the station of the Pennsylvania Railroad; elevation, 27.82 feet. This bench mark is No. 9 of the Pennsylvania Railroad and has an elevation of 72.69 feet above sea level. The bridge to which the original gage was attached was carried away in the flood of October 10–11, 1903, and from that date until July 22, 1904, gage heights were read from a temporary gage on one of the piers. On the latter date a standard chain gage was attached to the new steel bridge which occupies the site of the old wooden bridge and set to the same datum as the original chain gage; length of chain, 30.46 feet. The gage is read twice daily by Charles H. Naylor, collector of tolls. At the time the new gage was installed a second bench mark was established on the top of the bolt in the fifth course below the coping on the upstream face of the left abutment; elevation, 14.82 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, pp 84–85; WS 15, p 7; 27, p 9; 35, pp 62–63; 47, p 80; 65, p 214; 82, p 133; 97, pp 249–250; 125, pp 99–100.
Discharge: WS 15, p 7; 27, p 23; 35, p 63; 47, p 80; 65, p 214; 82, p 134; 97, p 250; 125, p 100.
Discharge, monthly: Ann 20, iv, p 85; 21, iv, p 77; 22, iv, p 112; WS 75, p 27; 82, p 135.
Discharge, yearly: Ann 20, iv, p 48.
Gage heights: WS 15, p 7; 27, p 16; 35, p 63; 47, p 80; 65, p 214; 82, p 134; 97, p 251; 125, p 100.
Hydrographs: Ann 20, iv, p 86; 21, iv, p 77; 22, iv p 113; WS 75, p 28.
Rating tables: WS 27, p 24; 39, p 442.

Discharge measurement of Delaware River at Lambertville, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 17	R. H. Bolster	811	3,615	0.94	2.90	[a]3,386

[a] Total discharge of river plus canal, 3,844 second-feet.

Daily gage height, in feet, of Delaware River at Lambertville, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.15	(a)	.....	8.7	3.75	2.7	2.3	3.15	3.25	4.1	4.25	6.9
2	5.1	.....	.....	7.8	3.7	2.7	2.35	3.55	3.6	4.05	4.2	6.1
3	5.0	.....	.....	6.95	3.65	2.6	2.35	3.65	4.6	3.95	4.2	5.85
4	(b)	.....	.....	6.25	3.55	2.5	2.6	3.75	5.4	3.9	4.15	8.83
5	.....	.....	.....	6.2	3.5	2.5	3.1	3.65	7.6	3.85	4.1	9.3
6	.....	.....	(c)	6.4	3.4	2.45	3.35	3.65	6.7	3.8	4.1	7.55
7	8.25	.....	.....	6.55	3.35	2.5	3.0	3.3	5.85	3.75	4.05	6.7
8	10.82	.....	.....	6.55	3.4	2.5	2.85	3.35	5.3	3.75	4.2	6.15
9	9.75	.....	.....	6.05	3.45	3.1	2.8	3.15	5.0	3.6	4.3	5.85
10	8.05	.....	[d]4.9	5.8	3.4	3.3	2.55	3.1	4.75	3.55	4.35	5.55
11	7.05	.....	4.9	5.55	3.3	3.2	2.6	2.95	4.65	3.45	4.3	5.45
12	6.55	.....	5.0	5.55	3.2	3.05	2.6	3.35	5.95	4.6	4.25	5.2
13	6.4	.....	4.55	5.45	3.15	2.85	3.05	3.7	7.37	5.45	4.2	5.1
14	6.1	.....	4.7	5.4	3.2	2.9	3.1	3.6	6.7	5.5	4.1	4.95
15	6.0	.....	4.55	5.25	3.4	3.15	3.35	4.1	5.95	5.15	4.1	4.75
16	5.2	.....	4.65	4.95	3.4	3.1	3.4	5.5	5.45	4.8	4.05	4.55
17	4.85	.....	4.8	4.75	3.25	2.95	3.1	4.85	5.15	4.55	3.95	4.6
18	4.9	.....	5.25	4.75	3.4	2.8	3.1	4.5	5.05	4.45	3.9	4.6
19	4.7	.....	6.52	4.6	3.25	2.6	3.05	4.4	5.1	4.35	4.0	4.5
20	4.75	.....	10.12	4.5	3.2	2.55	2.85	4.25	5.05	5.03	3.95	4.3
21	4.75	.....	11.69	4.45	3.15	2.5	3.0	3.95	5.3	5.4	3.8	5.1
22	4.65	.....	10.95	4.5	3.1	2.7	2.8	3.8	5.35	5.5	3.8	5.7
23	4.25	.....	10.0	4.55	3.05	2.85	3.1	3.55	5.5	5.25	3.65	5.75
24	4.15	.....	9.15	4.65	2.9	3.1	3.2	3.4	5.1	5.05	3.65	5.7
25	3.7	.....	9.4	4.5	2.9	3.2	3.2	3.5	4.85	4.9	3.65	5.4
26	(b)	.....	11.22	4.05	2.8	3.2	3.0	4.45	4.65	4.8	3.65	5.05
27	.....	.....	11.58	4.05	2.7	2.85	2.8	4.25	4.5	4.7	3.7	5.0
28	.....	.....	11.87	4.0	2.8	2.6	2.15	3.9	4.35	4.6	3.65	4.8
29	.....	.....	10.7	3.95	2.7	2.45	2.85	3.65	4.25	4.5	4.85	4.8
30	.....	.....	9.8	3.8	2.65	2.4	3.45	3.45	4.15	4.45	5.5	5.15
31	.....	.....	9.35	.....	2.7	.....	3.25	3.3	.....	4.35	.....	5.15

[a] River frozen entirely across.
[b] River frozen at gage.
[c] Channel open between first and second piers.
[d] Ice almost gone.

MUSCONETCONG RIVER NEAR BLOOMSBURY, N. J.

This station was established July 4, 1903, by E. P. Roundey. It is located at the first highway bridge over Musconetcong River above the village of Bloomsbury, N. J.

The channel is straight for 200 feet above and 100 feet below the station. Both banks are low and liable to overflow. At high stages part of the water flows around the bridge. The bed of the stream is composed of gravel.

Discharge measurements are made from the downstream side of the two-span highway bridge, to which the gage is attached. The initial point for soundings is the end of the hand rail on the right bank.

The original gage is a vertical cypress board spiked to the right abutment near the downstream end. A standard chain gage was installed at this station April 12, 1904, having the same datum as the staff gage; length of chain, 12.48 feet. Gage readings are taken twice each day by Michael Kieffer. The bench mark is a square chiseled on the top of the right abutment at its downstream end. Its elevation is 9.63 feet above the gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 254; 125, pp 102-103.
Discharge: 97, p 254; 125, p 103.
Gage heights: 97, p 254; 125, p 103.

Discharge measurements of Musconetcong River near Bloomsbury, N. J., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 18	F. H. Tillinghast	59	151	2.72	2.15	410
June 21	R. M. Packard	54	86	.95	1.07	81
July 10	Grover and Biggi	50	98	.79	1.03	77

Daily gage height, in feet, of Musconetcong River near Bloomsbury, N. J., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.42	1.95	1.45	2.28	1.5	1.15	1.0	1.2	0.98	1.0	1.05	1.55
2	1.45	1.82	1.35	2.25	1.42	1.18	1.0	1.12	1.0	1.08	1.08	1.4
3	1.48	1.72	1.32	2.12	1.28	1.18	1.15	1.05	1.32	.92	1.1	1.82
4	1.2	1.72	1.3	2.1	1.25	1.1	1.15	.98	2.05	.98	1.12	1.85
5	1.42	1.68	1.32	2.28	1.25	1.12	1.1	.95	1.6	1.05	1.02	1.82
6	1.38	1.65	1.35	2.42	1.2	1.08	1.1	.95	1.38	1.05	1.1	1.88
7	4.85	1.62	1.22	2.35	1.32	1.1	1.0	1.0	1.28	1.02	1.12	1.58
8	3.92	1.65	1.32	2.32	1.32	1.15	1.02	.98	1.18	.95	1.08	1.48
9	2.72	1.65	1.6	2.25	1.22	1.08	1.0	.98	1.05	1.1	1.1	1.42
10	2.4	1.62	2.12	2.22	1.18	1.12	1.02	.95	1.05	1.05	1.08	1.45
11	2.15	1.62	2.15	2.22	1.25	1.08	1.02	1.0	1.15	1.1	1.05	1.38
12	2.35	1.55	1.88	2.18	1.25	1.12	1.0	.92	1.85	1.4	1.0	1.35
13	2.25	1.8	1.82	2.02	1.25	1.2	1.05	.88	1.58	1.25	1.12	1.32
14	2.0	1.68	1.8	1.9	1.25	1.15	1.02	.98	1.32	1.12	1.12	1.25
15	1.8	1.72	1.8	1.92	1.3	1.12	.98	1.02	1.25	1.1	.92	1.1
16	1.75	1.6	1.9	1.88	1.3	1.12	.98	1.3	1.18	1.12	.95	1.1
17	1.85	1.65	2.08	1.98	1.25	1.12	1.02	1.12	1.12	1.08	1.12	1.2
18	1.75	1.58	2.5	1.98	1.25	1.05	1.02	1.08	1.25	1.0	1.08	1.15
19	1.78	1.6	3.48	1.92	1.2	1.1	.98	1.05	1.28	1.05	1.02	1.12
20	1.82	1.5	3.32	1.85	1.2	1.1	.92	.98	1.35	1.52	1.12	1.12
21	1.8	1.52	3.92	1.85	1.12	1.08	.98	.95	1.28	1.42	1.1	1.82
22	1.8	1.55	3.68	1.75	1.18	1.12	.9	.98	1.15	1.3	1.05	1.7
23	1.78	1.52	3.22	1.68	1.18	1.12	.92	.92	1.15	1.28	1.18	1.58
24	1.7	1.52	2.92	1.7	1.12	1.08	1.05	.95	1.12	1.22	1.12	1.5
25	1.32	1.5	3.32	1.58	1.1	1.08	1.0	1.38	1.08	1.3	1.08	1.4
26	4.3	1.48	3.65	1.48	1.12	1.12	.95	1.22	1.1	1.18	1.05	1.35
27	4.4	1.48	3.65	1.48	1.15	1.08	.95	1.12	1.02	1.1	1.1	1.32
28	3.12	1.45	3.6	1.48	1.1	1.0	.95	1.05	1.13	1.08	1.12	1.28
29	2.48	.....	2.92	1.4	1.12	1.08	.95	1.02	1.02	1.05	1.9	1.52
30	2.18	.....	2.6	1.35	1.1	1.05	.98	1.02	.98	1.08	1.75	1.52
31	2.02	.....	2.45	.....	1.1	.....	1.05	1.0	.....	1.12	.....	1.45

NOTE.—There was no ice at this station except around the middle pier and a narrow strip near one bank during February.

Station rating table for Musconetcong River near Bloomsbury, N. J., from July 4, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	56	1.50	190	2.10	388	2.70	618
1.00	69	1.60	220	2.20	424	2.80	658
1.10	86	1.70	251	2.30	461	2.90	698
1.20	107	1.80	283	2.40	499	3.00	739
1.30	132	1.90	317	2.50	538		
1.40	160	2.00	352	2.60	578		

The above table is applicable only for open-channel conditions. It it based on eight discharge measurements made during 1903-1905 between gage heights 1 foot and 2.9 feet. It is well defined between these heights. Above gage height 3 feet the rating curve is a rough approximation.

Estimated monthly discharge of Musconetcong River near Bloomsbury, N. J., for 1903-1905.

[Drainage area, 146 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
July 4-31	558	184	280	1.92	2.00
August	706	190	292	2.00	2.31
September	317	146	192	1.31	1.46
October	2,780	132	599	4.10	4.73
November	359	166	220	1.51	1.68
December	903	190	330	2.26	2.61
1904.					
January	1,408	154	335	2.29	2.64
February	1,877	146	329	2.25	2.43
March 1-7	1,498	267	503	3.44	.895
April 12-30	345	127	197	1.35	.954
May	205	92	142	.973	1.12
June	154	60	105	.719	.802
July	199	66	93.8	.642	.740
August	317	66	97.9	.671	.774
September	1,183	56	176	1.21	1.35
October	558	83	156	1.07	1.23
November	205	96	140	.959	1.07
December	283	96	135	.925	1.07
1905.					
January	1,542	107	454	3.11	3.58
February	334	175	227	1.55	1.61
March	1,126	112	507	3.47	4.00
April	507	146	336	2.30	2.57
May	190	86	113	.774	.892
June	107	69	88.1	.603	.673
July	96	57	71.2	.488	.563
August	154	53	77.4	.530	.611
September	370	66	124	.849	.947
October	196	59	96.2	.659	.760
November	317	59	96.6	.662	.739
December	310	86	177	1.21	1.40
The year	1,542	53	197	1.35	18.34

NOTE.—No correction made in estimates for the ice period. No gage-height record March 8 to April 11, 1904.

TOHICKON CREEK AT POINT PLEASANT, PA.

Tohickon Creek drains an area of 102 square miles in Bucks County, north of Philadelphia. It flows in an easterly course, entering Delaware River about 8 miles above Lambertville, N. J. Rudolph Hering, in the report of the Philadelphia water department for 1885, page 350, gives a classification of the drainage area of Tohickon Creek, from which it appears that 76 square miles are cultivated and improved and 26 square miles untillable and wooded.

Measurements of the discharge of the creek are made near its mouth at Point Pleasant. Rain gages are located within the basin at Quakertown, also at a point about 3 miles north of Bedminster, and near Point Pleasant.

Tables of daily discharge in second-feet, for the years 1883 to 1899, inclusive, are published in Water-Supply Paper No. 47, p. 81. Daily records of gage height were not kept during 1900. The following discharge record for 1905 was furnished by John E. Codman, hydrographer of the water department of Philadelphia.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; W S=Water-Supply Paper):

Description: WS 35, p 64; 47, p 81; 65, p 215; 82, p 138; 97, pp 251-252; 125, p 104.
Discharge: WS 65, p 215.
Discharge, daily: WS 35, p 64; 47, pp 81-89; 65, p 215; 82, p 139; 97, p 252; 125, p 104.
Discharge, monthly: Ann 20, iv, pp 98-102; 21, iv, p 83; 22, iv, pp 113-116; WS 75, p 28; 82, p 139; 125, p 105.
Discharge, yearly: Ann 20, iv, p 48.
Hydrographs: Ann 20, iv, p 103; 21, iv, pp 84, 85.

Daily discharge, in second-feet, of Tohickon Creek at Point Pleasant, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	79	58	53	73	26	8	5	6	27	16	34	313
2	120	58	43	61	26	7	9	4	18	21	34	223
3	154	58	36	54	23	4	7	5	224	26	23	869
4	154	72	39	51	23	7	9	5	911	32	21	820
5	186	79	35	317	23	5	8	6	606	35	25	224
6	278	64	32	764	23	12	5	5	152	29	26	112
7	4,174	58	33	307	20	9	3	4	68	23	24	84
8	952	58	126	122	17	8	5	17	44	15	23	73
9	255	58	605	84	15	12	3	31	39	16	23	67
10	193	58	1,568	83	14	11	2	34	28	21	24	92
11	119	58	934	129	14	5	2	28	46	12	16	104
12	398	58	841	169	14	3	6	19	1,129	158	14	76
13	485	58	721	138	11	7	3	11	423	128	21	59
14	220	58	675	91	15	11	4	14	120	51	15	50
15	145	58	636	75	15	10	5	1,237	60	31	19	48
16	111	58	767	68	20	9	5	3,353	45	29	15	43
17	89	58	996	57	11	9	3	376	26	24	16	39
18	87	58	1,776	50	10	6	2	109	93	21	17	39
19	87	58	2,657	46	25	4	3	52	229	20	14	32
20	75	72	1,611	40	26	5	3	34	181	817	9	24
21	64	79	2,302	42	18	5	2	28	392	573	16	1,061
22	61	64	1,271	48	17	5	2	24	166	162	14	652
23	58	58	662	44	18	14	11	18	72	82	12	318
24	58	58	482	35	10	21	3	15	46	56	11	226
25	58	58	1,189	32	10	12	2	623	39	51	14	98
26	58	58	611	36	8	12	3	742	34	53	13	82
27	58	58	434	43	8	13	5	176	28	58	8	69
28	58	58	511	40	7	7	4	72	21	48	16	64
29	72	.....	132	35	5	7	5	41	21	39	2,167	310
30	87	.....	104	30	6	5	36	30	20	36	1,206	374
31	72	.....	87	.....	10	.....	14	26	.....	32	.....	137

Estimated monthly discharge of Tohickon Creek at Point Pleasant, Pa., for 1905.

[Drainage area, 102 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,174	58	293	2.87	3.31
February	79	58	61.1	.599	.624
March	2,657	32	709	6.95	8.01
April	764	30	106	1.04	1.16
May	26	5	16.3	.160	.184
June	21	3	8.8	.086	.096
July	36	2	6.3	.062	.071
August	3,353	4	231	2.26	2.61
September	1,129	18	177	1.74	1.94
October	817	12	88	.863	.995
November	2,167	8	130	1.27	1.42
December	1,061	24	219	2.15	2.48
The year	4,174	2	170	1.67	22.92

NESHAMINY CREEK AT FORKS, PENNSYLVANIA.

The drainage basin of Neshaminy Creek is immediately south of that of Tohickon Creek and of a portion of that of Perkiomen Creek. The stream flows in a general southeasterly and southerly course, entering Delaware River at a point about 12 miles above Philadelphia. The point of measurement is at the forks of Big and Little Neshaminy creeks. The drainage area at this point is 139 square miles, of which 128 are cultivated and improved and 11 miles untillable and wooded. The daily discharges from 1884 to 1900 are given in Water-Supply Paper No. 47, pages 90 to 98. The table of daily discharge for 1905 was furnished by John E. Codman.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; W S=Water-Supply Paper):

Description: Ann 21, iv, p 85; WS 35, pp 64-65; 47, p 90; 65, p 216; 75, p 29; 82, p 140; 97, p 249; 125, p 105.
Discharge, daily: WS 35, p 65; 47, pp 90-98; 65, p 216; 82, p 140; 97, p 249; 125, p 106.
Discharge, monthly: Ann 20, iv, pp 104-107; 21, iv, p 86; 22, iv, pp 116-119; WS 82, p 141; 125, p 106.
Discharge, yearly: Ann 20, iv, p 48.
Hydrographs: Ann 20, iv, p 108; 21, iv, p 86; 22, iv, p 120.

Daily discharge, in second-feet, of Neshaminy Creek at forks, Pennsylvania, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	368	72	415	345	82	27	11	7	33	15	33	140
2	31	72	425	318	75	29	20	6	29	16	30	105
3	31	72	394	138	72	28	30	6	358	22	30	661
4	31	72	375	177	60	23	26	6	200	28	30	403
5	122	80	352	586	50	24	16	7	188	24	28	164
6	276	142	339	1,084	52	24	12	10	77	20	29	115
7	4,064	210	353	344	50	23	12	17	46	18	28	100
8	504	229	566	224	49	27	10	19	37	14	28	95
9	233	233	1,813	200	44	26	10	26	33	15	27	98
10	153	230	3,036	188	41	23	10	15	55	15	23	103
11	165	265	1,706	245	42	21	10	15	31	42	22	104
12	538	248	1,045	369	42	22	10	14	383	72	21	97
13	510	324	494	266	42	26	12	311	147	60	21	85
14	216	376	768	195	40	25	14	121	67	33	23	62
15	200	357	819	175	43	23	12	317	44	20	22	58
16	176	340	833	160	59	18	10	658	34	15	21	68
17	154	340	1,091	146	64	15	9	115	30	15	21	64
18	124	307	1,176	130	52	14	11	49	35	15	22	64
19	105	272	1,432	117	42	13	10	33	68	23	19	52
20	96	268	1,194	110	37	14	7	24	56	724	19	46
21	88	253	2,533	122	32	15	6	19	60	116	21	1,761
22	88	256	1,075	131	31	19	6	20	54	96	19	478
25	80	271	601	108	32	28	8	15	34	66	18	294
24	72	271	520	92	26	31	11	13	28	55	16	245
25	72	271	1,435	88	26	24	11	43	24	52	17	176
26	72	342	509	86	26	19	9	263	22	62	20	134
27	72	414	342	138	21	19	8	75	20	55	19	105
28	72	404	286	145	21	15	7	36	19	41	20	105
29	72	.....	249	97	22	12	6	26	20	41	1,165	476
30	72	.....	230	90	22	10	6	26	17	37	544	350
31	72	.....	213	.....	24	.....	7	31	.....	34	.....	166

Estimated monthly discharge of Neshaminy Creek at forks, Pennsylvania, for 1905.

[Drainage area, 139 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,064	31	288	2.07	2.39
February	414	72	250	1.80	1.87
March	3,036	213	859	6.18	7.12
April	1,084	86	221	1.59	1.77
May	82	21	42.9	.309	.356
June	31	10	21.6	.155	.173
July	30	6	11.5	.083	.096
August	658	6	75.9	.546	.630
September	383	17	75.5	.543	.606
October	724	14	60.3	.434	.500
November	1,165	16	78.8	.567	.633
December	1,761	46	225	1.62	1.87
The year	4,064	6	184	1.32	18.01

SCHUYLKILL RIVER NEAR PHILADELPHIA, PA.

This river receives the drainage of the portion of southeastern Pennsylvania lying between Lehigh River on the north and Susquehanna River on the south. It flows in a general southeasterly course into Delaware River, the city of Philadelphia being located at the junction of the streams.

Records of the height of the river at Fairmount pool have been kept for many years, but not in such form as to be useful in computing daily discharges. In 1898, however, careful estimates were prepared by John E. Codman, in charge of hydrographic work, bureau of water, city of Philadelphia, the results being given in the Twentieth Annual Report of the United States Geological Survey, Part IV, page 97.

The figures for daily discharge in the following table represent the total flow of the stream, computed from the amount wasted over the flashboards at the Fairmount dam, the pumpage from the river, the leakage, and also the quantity used for power at Fairmount. They were furnished by John E. Codman.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, pp 96–97; WS 35, pp 74–75; 48, p 109; 65, p 219; 82, p 142; 97, p 247; 125, p 107.
Discharge, daily: WS 35, p 75; 48, p 109; 65, p 219; 82, p 142; 97, p 247; 125, p 107.
Discharge, monthly: Ann 20, iv, p 97; WS 35, p 75; 48, p 110; 65, p 219; 82, p 142; 125, p 108.
Discharge, yearly: Ann 20, iv, p 48.
Hydrograph: Ann 20, iv, p 97.

Daily discharge, in second-feet, of Schuylkill River near Philadelphia, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,537	1,540	2,328	5,115	1,466	813	595	1,332	1,542	1,327	755	4,443
2	2,980	1,540	1,880	4,660	1,454	813	595	1,332	1,542	1,327	755	2,906
3	3,236	1,540	1,720	4,447	1,340	813	595	1,332	1,825	1,327	755	4,371
4	2,983	1,540	1,896	4,342	1,340	813	595	1,332	3,724	1,327	755	10,390
5	1,958	1,540	1,850	5,787	1,492	813	595	1,332	8,125	1,327	755	7,165
6	2,957	1,540	2,090	7,427	1,340	813	595	1,332	4,620	1,327	755	4,314
7	30,190	1,540	2,199	6,537	1,340	813	595	1,452	2,455	1,327	755	3,051
8	20,450	1,540	2,541	5,007	1,340	813	595	1,424	1,828	1,327	755	2,570
9	9,071	1,540	6,965	4,617	1,340	813	595	1,332	1,554	1,327	755	2,296
10	6,500	1,540	13,260	4,242	1,340	813	595	1,332	1,542	1,327	755	2,168
11	5,279	1,540	13,780	4,355	1,340	813	595	1,332	1,542	1,327	755	1,975
12	5,680	1,540	10,270	4,890	1,340	813	595	1,444	2,068	2,796	755	1,949
13	6,430	1,540	8,210	4,410	1,340	813	595	1,975	3,498	3,472	755	1,949
14	5,583	1,632	8,140	3,628	1,340	813	595	1,332	2,187	1,500	755	1,781
15	3,766	1,572	7,652	3,530	1,340	813	595	1,965	1,854	1,327	755	1,689
16	3,910	1,540	8,290	3,355	1,340	813	595	6,006	1,709	1,327	755	1,689
17	2,439	1,540	9,973	3,084	1,340	813	595	2,882	1,627	1,327	755	1,689
18	2,872	1,540	12,780	2,755	1,340	813	595	1,348	1,693	1,327	755	1,689
19	2,696	1,540	15,560	2,447	1,340	813	595	1,332	1,992	1,327	755	1,689
20	2,536	1,540	17,380	2,313	1,340	813	595	1,332	1,656	2,103	755	1,689
21	2,376	1,540	23,160	2,458	1,340	813	595	1,332	1,667	5,992	755	4,995
22	2,464	1,540	21,040	2,668	1,340	813	595	1,332	1,542	3,450	755	5,993
23	1,958	1,540	14,860	2,595	1,340	813	595	1,332	1,542	2,368	755	3,601
24	1,720	1,540	10,500	2,322	1,340	813	595	1,332	1,542	1,825	755	2,875
25	1,545	1,540	13,810	1,970	1,340	813	595	2,937	1,542	1,457	755	2,570
26	1,350	1,785	14,800	1,913	1,340	813	595	6,572	1,542	1,503	755	2,240
27	1,350	2,276	11,940	2,008	1,340	813	595	2,688	1,542	1,420	755	1,918
28	1,368	2,276	9,625	2,166	1,340	813	595	1,508	1,542	1,327	755	1,959
29	1,993	.....	8,025	2,011	1,340	813	595	1,332	1,542	1,327	5,825	2,248
30	2,324	.....	6,775	1,902	1,340	813	595	1,332	1,542	1,327	7,730	2,642
31	1,372	.....	5,885	.....	1,340	.....	595	1,332	.....	1,327	.....	2,432

Estimated monthly discharge of Schuylkill River near Philadelphia, Pa., for 1905.

[Drainage area, 1,915 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	30,190	1,350	4,641	2.42	2.79
February	2,276	1,540	1,606	.839	.874
March	23,160	1,720	9,329	4.87	5.62
April	7,427	1,902	3,634	1.90	2.12
May	1,492	1,340	1,353	.707	.815
June	813	813	813	.425	.474
July	595	595	595	.311	.358
August	6,572	1,332	1,855	.969	1.12
September	8,125	1,542	2,138	1.12	1.25
October	5,992	1,327	1,788	.934	1.08
November	7,730	755	1,156	.604	.674
December	10,390	1,689	3,063	1.60	1.84
The year	30,190	595	2,664	1.39	19.02

PERKIOMEN CREEK AT FREDERICK, PA.

Perkiomen Creek drains an area lying northwest of the city of Philadelphia. It flows southward, uniting with Schuylkill River about 7 miles above Norristown and about 18 miles above Philadelphia.

The point of measurement of discharge is located at Frederick, about 12 miles above the mouth, and also above two large tributaries known as West Swamp Creek and Northeast Branch of Perkiomen Both of these tributaries have been measured—the first at Zieglerville and the second at Schwenkville. The drainage area of the Perkiomen above the point of measurement is given by Rudolph Hering as 152 square miles, of which 111 are cultivated and improved and 41 untillable and wooded.

Measurements of this creek were begun on August 20, 1884. Water-Supply Paper No. 35, page 65, contains tables of the daily discharge for the entire period from 1884 to 1899, inclusive. The records of daily discharge for 1905, as furnished by John E. Codman, are given in the table below.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, pp 89-90; WS 35, p 65; 47, p 98; 65, p 217; 82, pp 135-136; 97, p 248; 125, p 108.
Discharge, daily: WS 35, pp 66-73; 47, p 99; 65, p 217; 82, p 136; 125, p 109.
Discharge, monthly: Ann 20, iv, pp 90-93; 21, iv, p 78; 22, iv, pp 121-123; WS 75, p 29; 82, p 137; 125, p 110.
Discharge, yearly: Ann 20, iv, p 48.
Hydrographs: Ann 20, iv, p 94; 21, iv, pp 79, 80.

Daily discharge, in second-feet, of Perkiomen Creek at Frederick, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	251	128	150	212	103	49	27	31	125	45	84	323
2	488	128	128	176	110	47	32	30	83	43	79	207
3	376	128	128	163	105	47	45	34	655	217	65	703
4	326	128	128	165	95	41	46	39	1,026	146	54	1,654
5	267	128	123	410	93	38	49	29	477	92	54	701
6	322	168	123	814	95	44	58	84	220	79	65	322
7	5,708	208	128	321	93	54	49	217	145	68	80	224
8	837	198	162	243	87	59	40	123	110	58	72	196
9	380	198	539	198	81	56	40	109	88	54	65	155
10	328	219	1,392	188	84	47	39	87	79	53	65	146
11	261	219	1,812	310	75	39	36	68	164	195	55	168
12	596	231	1,829	279	65	41	37	53	1,937	582	48	150
13	602	307	1,060	233	65	54	49	44	401	115	50	119
14	301	332	734	137	62	55	58	39	216	112	50	114
15	234	280	697	78	63	47	52	438	162	83	43	96
16	205	242	884	113	74	44	45	3,241	130	75	48	121
17	162	224	1,220	145	80	81	38	273	112	73	54	75
18	128	219	2,018	136	87	35	31	142	443	75	46	71
19	128	203	2,486	128	92	34	30	88	392	92	43	76
20	153	198	1,473	128	81	33	29	60	423	1,063	48	66
21	173	204	3,019	130	63	32	29	53	507	570	54	1,136
22	152	200	1,267	135	52	39	26	48	206	335	57	514
23	137	189	810	122	52	60	19	44	155	273	54	372
24	117	173	547	117	50	61	25	63	129	119	57	305
25	167	170	1,501	120	45	53	31	1,393	111	111	53	185
26	140	190	683	106	78	50	30	697	101	127	43	146
27	135	279	610	106	43	45	32	235	105	175	44	140
28	162	201	645	111	31	36	30	142	107	94	60	132
29	137	.....	336	111	26	34	27	105	85	80	3,156	599
30	128	.....	292	103	34	32	29	104	58	81	893	350
31	128	.....	254	.....	48	.....	28	169	.....	84	.....	182

Estimated monthly discharge of Perkiomen Creek at Frederick, Pa., for 1905.

[Drainage area, 152 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,708	117	440	2.89	3.33
February	332	128	203	1.34	1.40
March	3,019	123	877	5.77	6.65
April	814	78	191	1.26	1.41
May	110	26	71.6	.471	.543
June	81	32	46.6	.307	.343
July	58	19	37.1	.244	.281
August	3,241	29	268	1.76	2.03
September	1,937	58	299	1.97	2.20
October	1,063	43	174	1.14	1.31
November	3,156	43	188	1.24	1.38
December	1,654	66	315	2.07	2.39
The year	5,708	19	259	1.71	26.35

WISSAHICKON CREEK NEAR PHILADELPHIA, PA.

Wissahickon Creek is the principal stream draining into Schuylkill River from the north below Perkiomen Creek. The records of daily discharge for 1905, as furnished by John E. Codman, are given in the following table:

Daily discharge, in second-feet, of Wissahickon Creek near Philadelphia, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	123	20	157	166	106	18	10	10	18	3	16	238
2	143	20	135	162	106	34	37	10	30	3	15	37
3	135	20	131	166	98	30	41	12	165	4	11	253
4	114	20	131	277	98	20	14	17	376	4	10	261
5	109	20	127	323	89	19	13	404	342	4	12	133
6	148	20	123	392	114	25	11	716	125	4	19	80
7	1,746	20	123	240	111	40	7	492	21	3	16	44
8	247	18	208	204	101	29	8	143	20	3	18	77
9	166	61	654	188	96	21	8	7	18	4	17	124
10	159	63	1,011	188	63	19	7	11	18	4	10	165
11	148	20	504	193	63	16	8	37	86	98	12	137
12	266	20	365	208	64	33	10	200	246	156	9	62
13	277	20	265	208	63	26	23	366	110	35	10	41
14	145	20	285	177	63	19	16	241	24	6	16	35
15	131	20	263	157	96	16	10	355	19	5	11	25
16	126	30	308	150	97	13	8	372	20	8	10	20
17	112	20	350	141	126	13	4	186	20	8	14	18
18	109	20	381	140	112	11	2	76	21	3	12	19
19	109	20	434	137	86	14	2	28	16	10	6	20
20	109	42	479	128	52	16	7	28	10	479	9	21
21	106	47	859	128	29	10	7	28	12	258	11	764
22	106	47	459	137	41	12	3	28	11	103	14	347
23	106	63	295	131	41	16	7	28	6	37	13	237
24	106	63	270	119	22	14	9	28	4	26	12	216
25	75	85	468	116	19	9	8	202	4	32	23	195
26	38	175	278	111	16	11	8	219	3	41	13	178
27	31	206	242	120	16	14	8	47	3	30	12	164
28	28	171	216	134	28	11	8	15	3	18	21	159
29	28	.....	183	128	25	10	10	17	3	13	367	335
30	31	.....	175	114	31	9	10	13	3	16	397	260
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Estimated monthly discharge of Wissahickon Creek near Philadelphia, Pa., for 1905.

[Drainage area, 64.6 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,746	25	171	2.65	3.00
February	206	18	49.0	.759	.790
March	1,011	123	325	5.03	5.80
April	392	111	173	2.68	2.99
May	126	16	68.0	1.05	1.21
June	40	9	18.7	.290	.324
July	41	2	11.2	.173	.199
August	716	7	141	2.18	2.51
September	376	3	58.9	.912	1.02
October	479	3	46.8	.725	.836
November	397	6	38.3	.593	.662
December	764	18	157	2.43	2.80
The year	1,746	3	94.2	1.46	19.94

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

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THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

MAY, 1906.

O

Water-Supply and Irrigation Paper No. 167 Series P, Hydrographic Progress Reports, 43

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART III.—Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin River Drainages

BY

N. C. GROVER and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART III.

By N. C. Grover and John C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys.

Fiscal year ending June 30—	
1895	$12,500
1896	20,000
1897	50,000
1898	50,000
1899	50,000
1900	50,000
1901	100,000
1902	100,000
1903	200,000
1904	200,000
1905	200,000
1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of

every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and Lower eastern Mississippi river drainages.
No. 170. Great lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

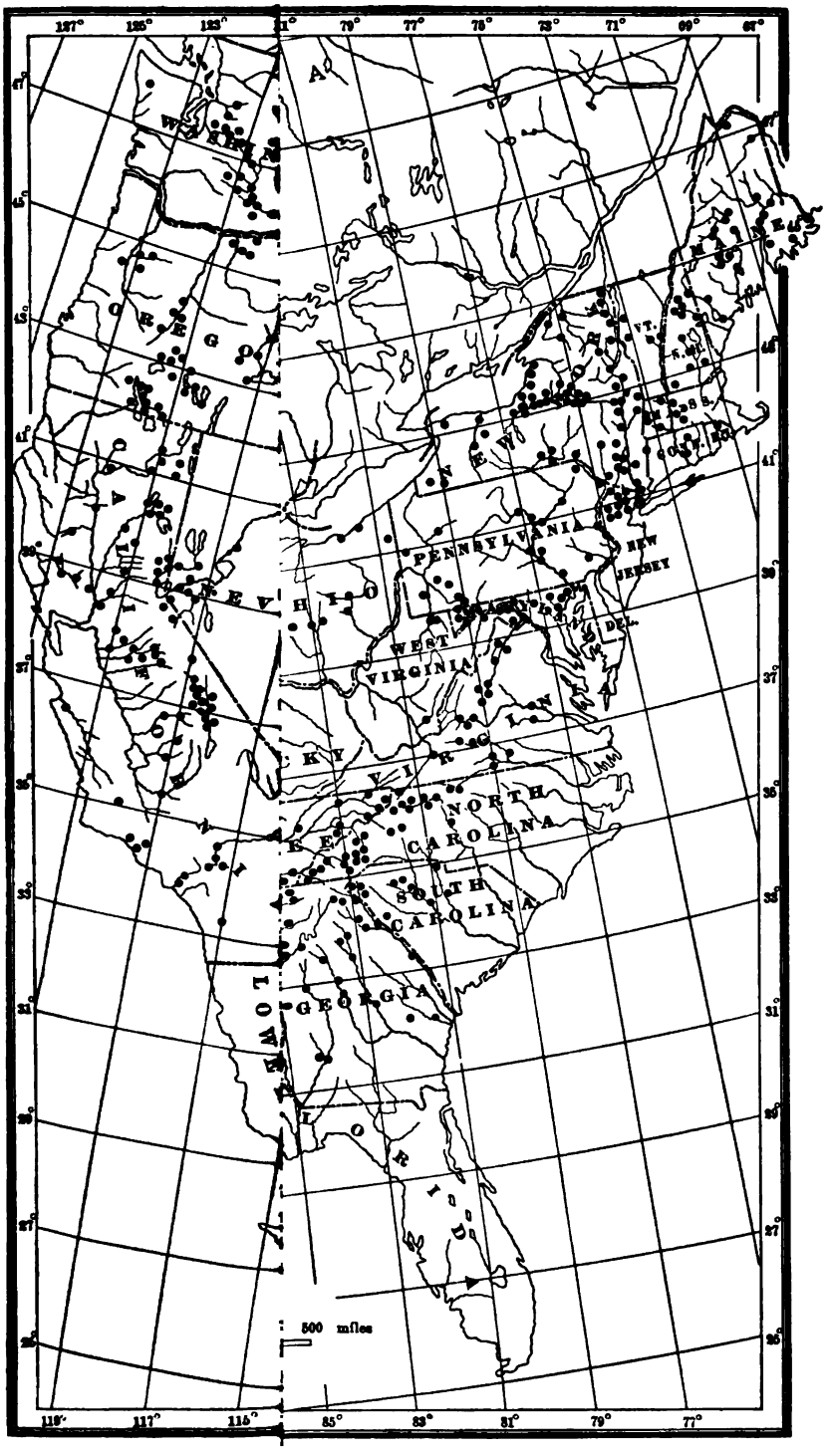
These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor northern Atlantic.


127°
125°
123°
81°
79°
77°
75°
73°
71°
69°
67°
WASH.
OREG.
CALIF.
NEV.
IDAHO
MONT.
WYO.
COLO.
N. MEX.
ARIZ.
UTAH
KANS.
OKLA.
TEX.
MINN.
IOWA
MO.
ARK.
LA.
MISS.
ALA.
GA.
FLA.
S. C.
N. C.
TENN.
KY.
VA.
W. VA.
OHIO
PENNSYLVANIA
N. Y.
VT.
N. H.
ME.
MASS.
CONN.
R. I.
N. J.
DEL.
MD.
500 miles
119°
117°
115°
85°
83°
81°
79°
77°

DURING 1905.

List of drainage basins in the United States—Continued.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor southern Atlantic.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadelupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountain.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square

under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest; this is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the two remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater then 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as close as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646.272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal .44 acre-feet.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.

1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec. ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025l\sqrt{h^3}$; l = length of weir in inches; h = head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1:125000, 1 mile=0.50688 inch.
Scale 1:90000, 1 mile=0.70400 inch.
Scale 1:62500, 1 mile=1.01376 inches.
Scale 1:45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general, the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas: (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of the water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

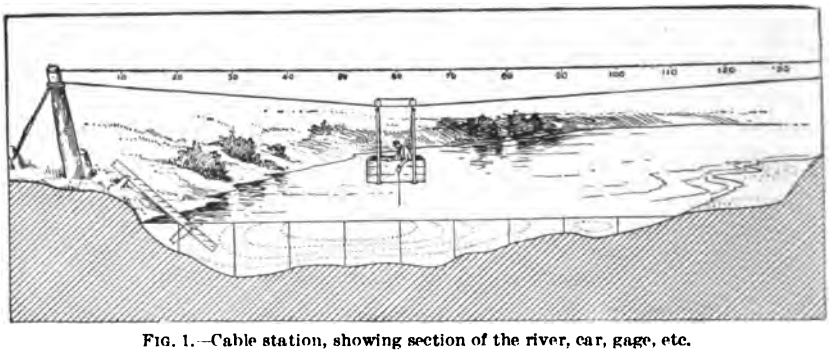


FIG. 1.—Cable station, showing section of the river, car, gage, etc.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying

from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; one-fifth and four-fifths depth; and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at one-fifth and four-fifths of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is based on the assumption that the vertical velocity-curve is a common parabola, in which the mean ordinate equals the mean of the ordinates at 0.2211 depth and at 0.7886 depth. Actual observations show that this law holds very closely.

In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at one-fifth, six-tenths, and four-fifths depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point in the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement,

either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical-velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve similar to that used for open channels. From such data as are available it has been found that for a given stage the flow under ice is about 60 per cent of that in open channel. The observed coefficients range from 46 per cent to 75 per cent. (See Water-Supply Paper No. 146, pp. 141–148.)

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage, if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each

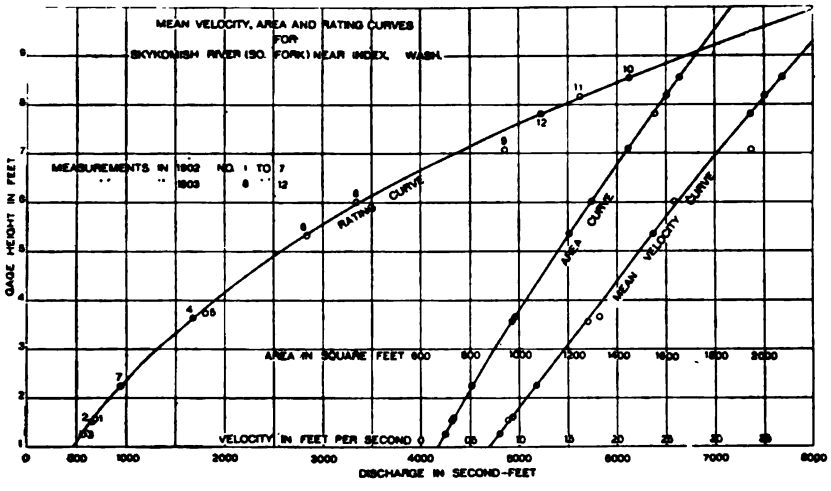


FIG. 2.—Discharge, mean-velocity, and area curves for Skykomish River (South Fork) near Index, Wash.

measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by

gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphic application of it, is also much used in estimating flow at stations where the bed shifts slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment s extended to other persons and corporations who have assisted these hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged geographically by States, gives the names of the hydrographers and others who have assisted in furnishing and preparing the data contained n this report:

Maryland.—District hydrographer, N. C. Grover, assisted by members of the inspecting and computing sections. Acknowledgment is due to the State Geological Survey for cooperation in the work to the extent of paying the observers.

New Jersey.—District hydrographer, N. C. Grover, assisted by members of the inspecting and computing sections.

Pennsylvania.—District hydrographer, N. C. Grover, assisted by members of the inspecting and computing sections. Acknowledgments are due to E. Mather, president of the board of water commissioners, and C. M. Nagle, chief engineer, Harrisburg; to James F. Fisher, city engineer of Williamsport, for cooperation in securing gage heights on Susquehanna River, and to Dr. Cary T. Hutchinson for discharge measurements and records of gage height at McCall Ferry.

Virginia.—District hydrographer, N. C. Grover, assisted by members of the inspecting and computing sections. Acknowledgments are due to the State Geological Survey for cooperation in the work, and to J. D. Hofford, manager of the Willson Aluminum Company at Holcomb Rock, for gage heights of James River at that place.

West Virginia.—District hydrographer, N. C. Grover, assisted by members of the inspecting and computing sections.

North Carolina.—District hydrographer, M. R. Hall, assisted by O. P. Hall and B. S. Drane. Dr. C. A. Schenck, director of the Biltmore School of Forestry, paid the gage readers at Davidsons River, Sitton, and Pinkbed.

SUSQUEHANNA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Susquehanna River rises in Otsego Lake, in northern Otsego County, N. Y., at an elevation of 1,193 feet above tide and flows in a general southerly direction into Chesapeake Bay. Its course is in many places extremely tortuous, crossing the State boundary between New York and Pennsylvania three times. The entire length of the river is about 500 m les, and it drains an area of 27,400 square miles, of which 21,060 square miles lie in Pennsylvania, 6,080 in New York, and 260 in Maryland.

The topography of the basin varies widely in character. In New York the stream and its tributaries flow through a rolling and in places rather broken country, bounded on the north by a mountainous area. In this part of the course its bed is of gravel or sand, with occasional rock ledges, and its banks are moderately high and not extensively subject to overflow. In Pennsylvania the river enters a mountain region, its banks are high, and it winds and twists among the parallel ranges in a bed composed generally of drift materials, gravel, sand, and bowlders. In the lower part of its course, from Marietta to Havre de Grace, it occupies a broad, deep valley, varying in width from a few hundred feet to more than a mile, and is for the most part bounded on either shore by rocky bluffs and tablelands elevated from 100 to 500 feet above its waters.

Above the mouth of the West Branch the fall of the stream is uniform and gradual; below that point the fall becomes more irregular, and there are at many places rapids where the stream flows over a rocky bottom. The elevation of the river at the mouth of the West Branch is 400 feet above mean sea level at Havre de Grace, the distance between the two points being 125 miles. The slope is, however, extremely variable.

In early days a complete system of canals was built along the river from the New York State line to the bay, but these have been abandoned with the establishment of railroads. The head of navigation is at the fall line, near the mouth of the stream, but various stretches are navigable for flat boats.

All available hydrographic data for Susquehanna River basin have been collected and published in Water-Supply and Irrigation Papers Nos. 108 and 109. No. 108 treats principally of the quality of the water, and No. 109 gives in detail information relative to fluctuations in stage and quantity of water flowing. No. 109 contains also records of flow at the gaging stations described in this paper and at the following additional stations:

West Branch at Allenwood, Pa.
Tioughnioga River at Chenango Forks, N. Y.
Cayuta Creek at Waverly, N. Y.
Chenango River at Oxford, N. Y.
Eaton and Madison brooks in Madison County, N. Y.
Diversions from Chenango River drainage basin.

During 1905 the United States Geological Survey has maintained the following gaging stations in this basin:

Susquehanna River at Binghamton, N. Y., and at Wilkesbarre, Danville, Harrisburg, and McCall Ferry, Pa.
Chenango River at Binghamton, N. Y.
Chemung River at Chemung, N. Y.
West Branch at Williamsport, Pa.
Juniata River at Newport, Pa.
Broad Creek at Mill Green, Md.
Deer Creek near Churchville, Md.

The United States Weather Bureau maintains river stations in this basin at the following points:

Susquehanna River at Towanda and Selinsgrove, Pa.
West Branch at Clearfield and Lock Haven, Pa.
Juniata River at Huntington, Pa.

SUSQUEHANNA RIVER AT BINGHAMTON, N. Y.

This station was established July 31, 1901. It is located at the Washington Street Bridge, about 800 feet upstream from the junction of Chenango and Susquehanna rivers.

On account of the unfavorable conditions produced by a rift which extends diagonally across the stream underneath the Washington Street Bridge, discharge measurements are made at the Exchange Street Bridge, 1,900 feet upstream.

A standard chain gage is attached to the upstream side of the left span of the Washington Street Bridge. The gage is upstream from the crest of the rift and over a stretch of smooth water extending to the dam, 2,800 feet above. Gage readings are unaffected by backwater from Chenango River at ordinary stages. The gage is read twice each day by William Ray Monroe. The bench mark is a chisel draft on the corner of the left bridge abutment on the upstream side. Its elevation is 23.71 feet above gage datum.

All records for this station for years prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Susquehanna River at Binghamton, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 17	H. R. Beebe	314	1,504	2.04	2.95	3,075
August 19	C. C. Covert	315	1,732	2.29	3.39	3,966
August 25	E. F. Weeks	308	1,227	1.22	2.32	1,501

Mean daily gage height, in feet, of Susquehanna River at Binghamton, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.72	3.04	2.38	9.08	2.98	2.25	2.85	2.98	4.6	2.56	2.54	5.55
2	4.7	3.14	2.42	7.42	2.85	2.22	3.05	3.35	3.6	2.46	2.56	3.75
3	5.32	3.07	2.08	6.22	2.78	2.25	3.32	3.0	3.2	2.48	2.66	8.67
4	4.52	2.87	2.08	5.55	2.72	2.28	2.92	2.6	6.12	3.53	2.61	11.05
5	3.42	2.87	2.15	6.9	2.62	2.3	2.8	2.48	10.6	3.13	2.51	8.2
6	3.34	2.74	2.1	7.48	2.75	2.9	2.65	2.38	9.9	2.78	2.58	6.1
7	5.84	2.67	2.42	7.38	2.9	3.7	2.52	2.32	6.48	2.48	3.01	5.13
8	7.2	2.79	2.08	6.7	2.9	3.1	2.38	2.32	5.12	2.38	3.28	4.73
9	5.87	2.59	2.1	5.88	2.75	2.88	2.35	2.4	4.35	2.36	3.21	4.37
10	4.81	2.54	2.15	5.38	2.65	2.82	2.32	2.3	3.72	2.33	3.01	4.23
11	4.06	2.7	2.45	5.45	2.7	2.55	2.25	2.25	3.5	2.35	2.84	4.0
12	3.91	3.0	2.48	6.28	2.62	2.48	2.28	2.32	5.3	5.57	2.76	3.74
13	4.73	2.56	2.45	5.98	2.55	2.5	2.18	2.75	5.5	5.55	2.74	3.46
14	5.03	3.13	2.48	5.2	2.55	2.52	2.25	2.7	4.48	4.22	2.66	3.46
15	4.26	2.54	2.4	4.72	2.6	2.52	2.15	2.55	3.75	3.45	2.64	3.14
16	3.71	2.92	2.3	4.68	2.95	2.35	2.18	2.88	3.45	3.09	2.56	2.76
17	3.49	2.75	2.3	4.4	2.92	2.25	2.15	4.15	3.35	2.87	2.56	2.69
18	3.41	2.8	2.8	4.25	2.85	2.2	2.15	4.15	4.15	2.79	2.51	2.96
19	3.51	2.7	5.72	4.05	2.85	2.3	2.15	3.32	5.1	2.79	2.44	2.76
20	3.19	2.75	9.02	3.75	2.85	2.42	2.22	2.92	4.53	3.55	2.48	2.76
21	3.05	2.38	9.95	4.0	2.7	2.7	2.28	2.75	4.5	3.52	2.43	2.96
22	2.95	2.3	9.25	4.78	2.6	7.52	2.35	2.52	4.48	3.32	2.33	4.82
23	2.72	2.28	8.52	4.28	2.5	7.3	2.1	2.5	3.76	3.07	2.3	5.12
24	2.8	2.42	8.18	3.8	2.42	5.7	2.42	2.42	3.43	2.92	2.27	4.46
25	3.12	2.2	12.65	3.55	2.38	4.3	2.05	2.4	3.2	2.85	2.3	3.66
26	3.25	2.2	14.7	3.35	2.45	3.6	2.62	2.32	3.03	2.69	2.3	3.26
27	3.3	2.65	13.9	3.2	2.45	3.25	2.32	2.28	2.86	2.59	2.33	2.96
28	3.25	2.15	13.6	2.08	2.45	3.3	2.15	2.28	2.73	2.57	2.35	2.92
29	3.45	.....	12.0	2.9	2.48	3.3	2.18	2.25	2.66	2.49	5.25	3.09
30	3.35	.....	10.6	.9	2.32	3.1	2.18	2.22	2.63	2.55	7.03	4.38
31	3.08	.....	10.18	.....	2.28	.....	2.22	3.42	.....	2.55	.....	4.22

NOTE.—During the entire frozen period there was an open channel of varying width at the gage. From January 26 to February 20, approximately, the river was frozen entirely across a short distance below the gage. Ice finally broke up March 18.

Station rating table for Susquehanna River at Binghamton, N. Y., from August 1, 1901, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.75	210	3.90	5,255	7.20	15,260	11.60	30,860
1.80	315	4.00	5,510	7.40	15,920	11.80	31,580
1.90	525	4.10	5,770	7.60	16,590	12.00	32,300
2.00	740	4.20	6,030	7.80	17,270	12.20	33,020
2.10	960	4.30	6,300	8.00	17,950	12.40	33,740
2.20	1,180	4.40	6,570	8.20	18,650	12.60	34,470
2.30	1,400	4.50	6,845	8.40	19,350	12.80	35,210
2.40	1,625	4.60	7,125	8.60	20,060	13.00	35,950
2.50	1,855	4.70	7,405	8.80	20,780	13.50	37,820
2.60	2,085	4.80	7,690	9.00	21,500	14.00	39,720
2.70	2,315	4.90	7,980	9.20	22,220	14.50	41,650
2.80	2,545	5.00	8,280	9.40	22,940	15.00	43,600
2.90	2,785	5.20	8,880	9.60	23,660	15.50	45,550
3.00	3,025	5.40	9,495	9.80	24,380	16.00	47,500
3.10	3,265	5.60	10,120	10.00	25,100	16.50	49,500
3.20	3,505	5.80	10,760	10.20	25,820	17.00	51,500
3.30	3,755	6.00	11,400	10.40	26,540	17.50	53,500
3.40	4,005	6.20	12,040	10.60	27,260	18.00	55,500
3.50	4,255	6.40	12,680	10.80	27,980	18.50	57,500
3.60	4,505	6.60	13,320	11.00	28,700	19.00	59,500
3.70	4,755	6.80	13,960	11.20	29,420	19.50	61,500
3.80	5,005	7.00	14,600	11.40	30,140	20.00	63,500

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1905. It is well defined between gage heights 2 feet and 5 feet. The table has been extended beyond these limits, being based on one measurement at 16.3 feet.

Estimated monthly discharge of Susquehanna River at Binghamton, N. Y., for 1905.

[Drainage area, 2,400 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January (1–25)	15,260	2,361	6,074	2.53	2.36
March (19–31)	42,430	10,500	27,510	11.46	5.54
April	21,790	2,785	8,847	3.69	4.12
May	2,977	1,356	2,219	.925	1.07
June	16,320	1,180	3,635	1.51	1.68
July	3,805	850	1,607	.670	.772
August	5,900	1,224	2,326	.969	1.12
September	27,260	2,154	7,145	2.98	3.32
October	10,020	1,466	3,166	1.32	1.52
November	14,700	1,334	2,740	1.14	1.27
December	28,880	2,292	6,868	2.86	3.30

NOTE.—Ice conditions January 26 to March 18, approximately; no estimates made.

SUSQUEHANNA RIVER AT WILKESBARRE, PA.

This station was established March 30, 1899, by E. G. Paul. It is located at the Market Street Bridge, Wilkesbarre, Pa.

The channel is straight for about one-fourth mile above and below the station. There is a bar across the river about one-half mile above the station and another at about the same

distance below, with deep water between these points. The right bank is low and overflows at a gage height of about 20 feet; the left bank is above ordinary floods. The bed of the stream is composed of sand and gravel and is somewhat shifting. The current is sluggish at low stages. There is but one channel, broken by three bridge piers. A few willows grow under the right span.

Discharge measurements are made from the downstream side of the bridge, which has a total span of 700 feet between abutments, and is at such an elevation above the river bed that 65 feet of cable is needed to sound across the section. The initial point for soundings is at the end of the iron hand rail on the left bank, downstream side. During low water measurements have been made by wading at a better cross section, at Retreat, 10 miles below Wilkesbarre.

A standard chain gage is attached to the upstream side of the left span of the bridge. The length of the chain from the end of the weight to the marker is 40.83 feet. The gage is read once each day by W. S. Bennett, the bridge keeper. The bench mark is the extreme west end of the stone door sill of the north entrance of the Coal Exchange Building. Its elevation is 32.99 feet above gage datum.

Since the establishment of this station the recorded gage height has had a maximum range of 28.5 feet, and the estimated discharge has been between the extremes of about 210,000 and 720 second-feet.

The United States Weather Bureau has also maintained a gage and has records at this place since 1888. The datum of the Bureau gage, which was attached to the left-hand pier, was the bottom of the dressed-stone portion of the pier, at an elevation reported to be 525 feet above sea level. During low stages of the river the water recedes from the pier; the datum of the Geological Survey gage was therefore placed 4 feet below the zero of the Weather Bureau gage, so as to obviate minus readings. The Geological Survey gage, soon after its establishment, was adopted by the Weather Bureau, which has continued to use it, and since April 1, 1905, when the Geological Survey discontinued reading the gage, the gage heights have been furnished by the Weather Bureau.

The danger mark of the gage is at 18 feet (14 feet on the old Weather Bureau gage), as at this elevation the west bank of the river is under water in places.

Observations of fluctuations of the Susquehanna are made by the Weather Bureau above Wilkesbarre, at Towanda, Pa., where the drainage area is estimated to be 8,000 square miles. The river gage, made of iron, 1 foot wide and one-half inch thick, is on the east side of the road bridge over Susquehanna River, and is securely bolted to the masonry of the pier. The graduation is from 0 to 25 feet. The highest water was 29 feet, in March, 1869, and the lowest —0.1 foot, in October, 1895; the danger line is at 18 feet. The elevation of the zero is 633.7 feet above sea level.

All records and estimates for this station prior to 1905 made by the United States Geological Survey have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Susquehanna River at Wilkesbarre, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 22[a]	J. C. Hoyt	669	16,150	5.85	19.2	94,400
March 22[a]	do	669	16,150	6.27	19.2	101,200
March 23	do	666	12,900	5.84	17.85	75,110
March 24	do	666	12,340	5.90	17.08	72,800
March 25	do	666	14,710	7.21	20.6	106,100
March 28	H. D. Comstock	648	15,130	7.16	21.3	108,400
March 29	G. F. Harley	660	14,290	6.84	19.97	97,680

[a] Ice-float measurement above bridge.

Mean daily gage height, in feet, of Susquehanna River at Wilkesbarre, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.8	6.8	3.8	15.2	5.5	3.8	5.2	4.1	3.3	4.2	4.3	9.8
2	8.0	6.6	3.8	13.7	5.4	3.6	4.9	4.7	3.4	4.1	4.2	9.2
3	8.2	6.4	3.6	12.0	5.3	3.6	4.8	4.6	5.9	4.0	4.3	7.6
4	8.3	6.1	3.5	10.4	5.1	3.5	8.0	5.0	5.7	4.0	4.7	14.8
5	10.5	5.9	3.5	9.3	4.9	3.4	6.2	4.6	6.1	4.0	4.6	16.0
6	11.5	5.9	3.4	10.0	4.8	3.5	5.5	4.3	9.2	4.7	4.3	13.0
7	14.6	5.9	3.4	12.4	4.7	3.6	4.9	4.0	11.2	4.7	4.4	10.6
8	14.1	5.6	3.3	12.1	4.8	5.5	4.7	3.8	9.8	4.2	4.5	9.0
9	13.4	5.5	3.8	11.0	5.0	5.8	4.4	3.6	7.7	4.0	5.3	8.2
10	11.2	5.4	3.9	10.0	5.0	5.5	4.3	3.5	6.7	3.8	5.6	7.9
11	9.6	5.4	4.4	9.2	4.7	5.1	4.2	3.6	6.0	3.7	5.4	7.6
12	8.2	5.2	4.6	9.2	4.7	4.8	4.3	3.8	6.0	4.6	5.2	7.3
13	8.2	4.9	4.6	9.7	4.6	4.7	4.0	5.7	6.6	7.2	4.9	6.7
14	7.8	4.8	4.6	9.8	4.5	4.9	4.0	4.9	8.2	8.5	4.8	6.3
15	7.7	4.8	4.5	8.9	4.4	4.7	4.0	5.1	7.6	7.7	4.6	6.0
16	12.3	4.8	4.5	8.1	4.4	4.5	3.9	5.4	6.6	6.6	4.6	5.8
17	11.0	4.7	4.6	8.0	4.4	4.3	3.9	5.3	5.8	5.7	4.5	5.0
18	10.6	4.7	5.3	7.8	4.7	4.0	3.9	5.3	5.7	5.3	4.3	4.7
19	10.8	4.7	15.0	7.5	4.8	3.9	3.9	5.8	5.6	4.9	4.3	4.6
20	10.9	4.6	19.0	7.2	4.6	5.2	3.7	5.6	7.5	5.0	4.2	4.8
21	10.9	4.6	19.1	6.9	4.5	7.0	3.7	5.0	7.4	6.1	4.2	4.9
22	10.1	4.6	19.2	6.8	4.5	7.3	3.6	4.5	6.8	6.6	4.1	6.0
23	9.3	4.5	18.0	8.3	4.4	13.3	3.5	4.2	6.6	6.4	3.9	9.5
24	8.4	4.4	17.1	8.4	4.3	12.4	3.4	4.1	6.2	5.8	3.8	10.0
25	7.5	4.3	20.4	7.4	4.1	10.1	3.4	4.0	5.6	5.5	3.7	9.3
26	6.5	4.1	23.4	6.8	4.0	8.3	4.7	3.9	5.2	5.3	3.6	7.5
27	5.6	3.9	22.6	6.4	3.9	7.0	4.6	3.7	4.9	5.1	3.6	6.7
28	5.2	3.8	21.3	6.1	3.8	6.0	4.3	3.6	4.6	4.9	3.7	6.4
29	6.2	.....	20.0	5.8	3.7	5.6	4.0	3.4	4.5	4.7	3.9	6.0
30	6.4	.....	18.3	5.7	4.0	5.4	3.7	3.3	4.3	4.5	5.4	6.2
31	6.7	.....	16.3	.....	3.9	.....	3.6	3.3	.....	4.4	.....	8.8

NOTE.—From January 15 to February 23 the river was frozen entirely across, except for a narrow channel near the east bank. Gage readings are to water surface in hole cut in ice. Thickness of ice, 1 to 1.2 feet. From February 24 to March 4 the ice gradually broke up. The following comparative readings were made:

Date.	Water surface.	Top of ice.
	Feet.	*Feet.*
February 8	5.6	5.6
February 17	4.7	4.7
February 23	4.5	4.5
February 25	4.3	4.3

Station rating table for Susquehanna River at Wilkesbarre, Pa., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	620	3.80	3,780	6.20	11,470	12.50	42,430
2.10	720	3.90	4,030	6.40	12,240	13.00	45,400
2.20	820	4.00	4,280	6.60	13,020	13.50	48,510
2.30	930	4.10	4,540	6.80	13,810	14.00	51,700
2.40	1,050	4.20	4,800	7.00	14,610	14.50	54,990
2.50	1,180	4.30	5,070	7.20	15,430	15.00	58,400
2.60	1,320	4.40	5,340	7.40	16,270	15.50	61,900
2.70	1,470	4.50	5,620	7.60	17,130	16.00	65,500
2.80	1,630	4.60	5,910	7.80	18,010	16.50	69,250
2.90	1,810	4.70	6,210	8.00	18,910	17.00	73,000
3.00	2,000	4.80	6,520	8.50	21,250	17.50	76,900
3.10	2,200	4.90	6,830	9.00	23,700	18.00	80,900
3.20	2,410	5.00	7,150	9.50	26,210	18.50	84,900
3.30	2,620	5.20	7,800	10.00	28,760	19.00	89,100
3.40	2,840	5.40	8,490	10.50	31,340	19.50	93,350
3.50	3,070	5.60	9,210	11.00	33,960	20.00	97,800
3.60	3,300	5.80	9,950	11.50	36,670	21.00	106,800
3.70	3,540	6.00	10,710	12.00	39,510	22.00	116,300

NOTE.—The above table is applicable only for open-channel conditions. It is based on 25 discharge measurements made during 1899–1905. It is well defined between gage heights 2.2 feet and 21 feet. The table has been extended beyond these limits. Below gage height 6 feet the table is the same as for 1904.

Estimated monthly discharge of Susquehanna River at Wilkesbarre, Pa., for 1905.

[Drainage area, 9,810 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January (1–14)[a]	55,660	18,010	30,360	3.09	1.61
March	130,300	2,620	41,090	4.19	4.83
April	59,800	9,580	24,550	2.50	2.79
May	8,850	3,540	5,873	.599	.691
June	47,250	2,840	10,750	1.10	1.21
July	18,910	2,840	5,487	.559	.644
August	9,950	2,620	5,466	.557	.642
September	35,030	2,620	12,660	1.29	1.44
October	21,250	3,540	8,085	.824	.950
November	9,210	3,300	5,527	.563	.628
December	65,500	5,910	20,030	2.04	2.35

[a] River frozen January 15 to February 28, approximately; no estimates.

SUSQUEHANNA RIVER AT DANVILLE, PA.

This station was established March 25, 1899, by E. G. Paul. It is located at Mill Street Bridge, 600 feet south of the public square, Danville, Pa., near the Pennsylvania Railroad station, South Danville. It is 52 miles below Wilkesbarre and 11 miles above the mouth of the West Branch.

The channel is straight for about one-half mile above and below the station. The right bank is liable to overflow in extreme freshets. The bed is rocky, with some gravel, and is permanent. The current is good except at extreme low water.

On March 9, 1904, the bridge and gage were carried away in the ice freshet, and from that date until the new steel bridge was in position observations were made from temporary gages and were constantly liable to error. The new bridge rests upon the same piers which supported the bridge that was washed away. The total span of the bridge is about 1,300 feet, broken by six piers, which do not obstruct the flow of the stream to any considerable extent.

On March 24, 1905, a standard chain gage was attached to the hand rail on the upper side of the new bridge in the first span from the right bank. The length of the chain from the end of the weight to the marker is 44.76 feet. On July 8, 1905, the gage was moved and attached to the hand rail on the lower side of the bridge in the first span from the right bank. In both positions it was made to read from the datum of former gages. The gage is read once each day by Ed. F. Bell. The bench mark is the extreme south end of the stone doorsill at the east entrance to the city filtration plant. Its elevation is 31.70 feet above gage datum.

Since the establishment of the gage the record shows a range in gage height of nearly 25 feet, and the extremes of high and low water within that period are estimated at about 280,000 and 830 second-feet, respectively.

All records and estimates for this station for years prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Susquehanna River at Danville, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 23	J. C. Hoyt	1,272	15,290	5.96	14.50	91,160
March 24	H. D. Comstock	1,272	14,300	5.89	13.72	84,240
March 26	Harley and Comstock	1,272	20,530	7.07	18.62	145,100
March 27	H. D. Comstock	1,272	19,780	6.94	18.02	137,300
March 28	G. F. Harley	1,272	18,280	6.56	16.85	119,900
March 30	do	1,272	15,420	5.94	14.63	91,630
March 31	do	1,272	13,620	5.67	13.21	77,180
April 1	do	1,272	12,050	5.32	11.97	64,110
April 3	do	1,264	9,324	4.91	9.83	45,790
July 8	Grover and Biggl	870	2,893	2.67	3.90	7,720

Mean daily gage height, in feet, of Susquehanna River at Danville, Pa., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	11.95	4.5	3.2	4.2	3.0	2.9	3.5	3.7	5.8
2	.....	11.1	4.4	3.1	4.1	3.3	2.8	3.4	3.6	7.1
3	.....	9.6	4.3	3.0	4.0	3.7	4.35	3.4	3.5	8.25
4	.....	8.4	4.2	2.9	3.9	3.9	5.5	3.3	3.7	10.75
5	.....	7.45	4.1	2.9	5.6	4.0	5.7	3.3	3.8	13.15
6	.....	7.5	4.0	2.9	5.0	4.0	6.4	3.3	3.7	11.20
7	.....	9.2	4.0	3.0	4.8	3.8	9.2	3.8	3.9	9.2
8	.....	9.35	4.1	3.1	3.9	3.4	8.9	3.7	4.0	7.75
9	.....	8.9	4.1	4.6	3.7	3.3	7.0	3.5	4.2	6.9
10	.....	8.05	4.0	4.5	3.5	3.2	5.8	3.3	4.4	6.7
11	.....	7.45	4.0	4.3	3.5	3.0	5.1	3.3	4.4	6.3
12	.....	7.3	3.9	4.1	3.4	3.1	5.7	4.7	4.2	6.0
13	.....	7.4	3.8	4.0	3.6	3.5	5.9	5.75	4.2	5.6
14	.....	7.75	3.8	3.8	3.5	4.7	6.4	6.85	4.1	5.3
15	.....	7.25	3.7	4.0	3.3	4.2	6.5	6.6	3.9	5.0
16	.....	6.7	3.7	3.9	3.3	5.2	5.9	5.8	3.8	7.7
17	.....	6.5	3.6	3.7	3.3	5.0	5.2	5.0	3.7	4.8
18	.....	6.5	3.7	3.5	3.2	4.5	4.9	4.6	3.7	3.9
19	.....	5.95	3.8	3.4	3.2	4.4	4.7	4.3	3.5	3.9
20	.....	5.65	3.9	3.3	3.1	4.8	5.2	4.2	3.5	3.8
21	.....	5.55	3.8	5.9	3.0	4.5	6.2	5.0	3.4	4.0
22	.....	5.6	3.7	5.6	3.0	4.0	5.7	5.5	3.4	4.7
23	14.5	5.85	3.6	7.8	3.0	3.7	5.9	5.5	3.4	5.4
24	13.72	6.5	3.6	9.8	2.9	3.5	5.2	5.2	3.3	6.8
25	.....	6.3	3.5	8.8	2.8	3.6	4.8	4.7	3.2	7.6
26	18.62	6.1	3.4	7.3	2.8	3.4	4.4	4.5	3.2	6.7
27	18.02	5.9	3.4	6.0	3.9	3.3	4.1	4.3	3.2	6.5
28	17.05	5.2	3.3	5.7	3.6	3.1	3.9	4.2	3.7	6.0
29	15.95	4.8	3.3	4.6	3.5	3.0	3.8	4.1	4.3	5.4
30	14.45	4.6	3.4	4.4	3.4	2.9	3.6	3.9	4.7	5.2
31	12.95	.....	3.4	.....	3.3	2.9	.....	3.8	.....	5.1

Station rating table for Susquehanna River at Danville, Pa., from March 23 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	3,280	5.10	13,390	8.80	36,680	13.40	78,640
2.90	3,580	5.20	13,940	9.00	38,200	13.60	80,780
3.00	3,900	5.30	14,490	9.20	39,740	13.80	82,940
3.10	4,230	5.40	15,040	9.40	41,320	14.00	85,120
3.20	4,570	5.50	15,600	9.60	42,920	14.20	87,320
3.30	4,920	5.60	16,160	9.80	44,560	14.40	89,560
3.40	5,280	5.70	16,720	10.00	46,220	14.60	91,820
3.50	5,650	5.80	17,290	10.20	47,900	14.80	94,100
3.60	6,040	5.90	17,860	10.40	49,620	15.00	96,420
3.70	6,450	6.00	18,430	10.60	51,360	15.20	98,760
3.80	6,880	6.20	19,590	10.80	53,120	15.40	101,140
3.90	7,330	6.40	20,770	11.00	54,920	15.60	103,560
4.00	7,780	6.60	21,960	11.20	56,740	15.80	106,020
4.10	8,230	6.80	23,160	11.40	58,580	16.00	108,520
4.20	8,690	7.00	24,400	11.60	60,460	16.20	111,060
4.30	9,160	7.20	25,660	11.80	62,380	16.40	113,640
4.40	9,660	7.40	26,940	12.00	64,320	16.60	116,260
4.50	10,170	7.60	28,260	12.20	66,280	16.80	118,920
4.60	10,690	7.80	29,580	12.40	68,280	17.00	121,620
4.70	11,220	8.00	30,940	12.60	70,300	17.50	128,620
4.80	11,760	8.20	32,320	12.80	72,340	18.00	135,900
4.90	12,300	8.40	33,740	13.00	74,420	18.50	143,400
5.00	12,840	8.60	35,200	13.20	76,520		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1899-1905. It is fairly well defined between gage heights 1.5 feet and 19 feet. Below 4.5 feet the table is the same as for 1904.

Estimated monthly discharge of Susquehanna River at Danville, Pa., for 1905.

[Drainage area, 11,070 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March (8 days)	145,200	73,900	106,000	9.58	2.85
April	63,830	10,690	26,690	2.41	2.69
May	10,170	4,920	6,974	.630	.726
June	44,560	3,580	11,620	1.05	1.17
July	16,160	3,280	6,256	.565	.651
August	13,940	3,580	6,885	.622	.717
September	39,740	3,280	15,520	1.40	1.56
October	23,470	4,920	10,060	.909	1.05
November	11,220	4,570	6,879	.621	.693
December	75,990	6,880	22,910	2.07	2.39

SUSQUEHANNA RIVER AT HARRISBURG, PA.

Regular daily observations of the stage of Susquehanna River at Harrisburg were started in 1890 by E. Mather, president of the Harrisburg water board. The observations have been continued since that time and have been furnished to the United States Geological Survey through the courtesy of Mr. Mather.

The gage is located in the pump well at the pump house of the city waterworks, the well being connected with the river by two large mains. The datum of the gage is the low-water mark of 1803, and is marked on a large sloping rock, about 40 feet from the left bank at low water and about halfway between the Walnut Street Bridge and the pumping station. The original readings are taken in feet and inches, and for convenience in computations have been reduced to feet and tenths. In the summer of 1904 certain changes and improvements were made at the pumping station and a partial dam was made in the river just below it. The effect of this dam was to raise the apparent stage of the water at the gage. Observations at this gage are made by the engineer, C. M. Nagle, each morning before starting the pumps.

The first discharge measurement at this station was made in March, 1897, by E. G. Paul, and measurements have been made here by the engineers of the United States Geological Survey since that date. The measuring section is at the lower side of the Walnut street toll bridge, at which point the river is divided into two channels by Fosters Island, which is here about 1,200 feet wide. This island has low, sloping banks, and during extreme floods is completely overflowed. At ordinary stages the left channel is 1,350 feet wide, broken by six bridge piers; the right channel is 1,300 feet wide, broken by seven piers. The banks of the river are high. The bed is composed of hard material and is permanent, except in the spans adjacent to the island. The velocity never becomes too sluggish to measure.

The initial point for soundings is the upright at the end of the hand rail on the downstream side at the left bank.

On July 18, 1904, a standard chain gage was attached to the guard rail on the upstream side of the Walnut Street Bridge in the left-hand span. The length of the chain is 39.38 feet. The gage is read once each day by Thomas Numbers, the toll collector. The datum of this gage is also the low-water mark of 1803, and it is believed that it records truly the stage of the river to that datum, and that the changes in bridges below or in the pumping station above do not appreciably affect the records obtained from it. The datum is referred to a bench mark on the left abutment at the top upstream outer corner of the bridge seat; elevation, 32.92 feet.

During the summer and spring of 1903 a new bridge was built across the Susquehanna at Market street, which is about 1,200 feet below the gaging station. The piers of this new bridge obstruct the channel of the river by between 10 and 15 per cent of the total cross section. In the latter part of 1903 and early in 1904 the old piers on this site were removed, so that the river channel was left in such condition that the effect on the stage of the river at the Walnut Street Bridge remained practically unchanged.

All records and estimates for this station prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Susquehanna River at Harrisburg, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 22	Robert Follansbee	2,678	44,720	6.19	15.72	276,800
March 23	do	2,678	39,940	5.58	13.96	223,000
March 25	do	2,678	33,230	5.34	11.45	177,600
March 26	Hoyt and Follansbee	2,678	40,300	5.98	14.06	240,800
March 27	Follansbee and Morse	2,678	38,430	5.88	13.36	225,900
March 28	do	2,678	36,830	5.70	12.76	209,900
March 28	do	2,678	36,090	5.65	12.50	204,000
March 29	H. M. Morse	2,675	32,940	5.34	11.37	176,000
March 29	do	2,675	33,610	5.37	11.62	180,600
March 30	do	2,668	30,950	5.11	10.58	158,100
March 31	do	2,668	27,900	4.79	9.44	133,700
March 31	do	2,668	27,190	4.74	9.15	128,900
April 1	do	2,657	24,960	4.47	8.30	111,600
April 4	G. F. Harley	2,602	18,380	3.47	5.79	63,790
July 5	N. C. Grover	2,479	9,534	1.61	2.39	15,310
July 6	do	2,571	11,230	2.05	2.97	22,980

Mean daily gage height, in feet, of Susquehanna River at Harrisburg, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.8	4.8	3.7	8.3	3.1	1.9	2.7	2.0	1.85	1.8	2.4	5.3
2	5.11	4.8	3.7	7.45	3.0	1.9	2.5	1.9	1.8	1.75	2.3	6.4
3	5.8	4.8	3.6	6.8	2.8	2.0	2.45	2.0	1.8	1.8	2.3	6.2
4	5.2	4.6	3.55	6.0	2.7	1.85	2.35	2.1	2.1	1.75	2.3	11.25
5	4.4	4.6	3.4	5.3	2.6	1.85	2.35	2.2	4.5	1.8	2.3	12.18
6	5.2	4.6	3.55	4.95	2.5	1.8	3.05	2.1	3.9	1.8	2.35	10.0
7	5.5	4.6	3.6	5.05	2.45	2.0	2.85	2.45	3.5	1.8	2.35	8.15
8	9.9	4.4	3.7	5.8	2.5	2.2	2.55	2.2	4.9	1.9	2.3	6.7
9	8.7	4.4	4.02	5.7	2.5	3.3	2.3	2.05	4.4	1.9	2.4	5.7
10	7.9	4.4	4.8	5.3	2.5	3.7	3.0	1.9	3.5	1.7	2.4	5.1
11	6.5	4.4	5.5	5.0	2.5	3.7	3.15	2.45	3.0	1.6	2.7	4.65
12	5.4	4.0	8.1	4.8	2.45	3.3	2.85	1.95	3.1	2.15	2.7	4.4
13	5.3	4.1	7.45	5.0	2.35	3.1	2.5	2.5	3.6	3.5	2.6	4.1
14	4.8	4.0	7.0	5.4	2.4	3.15	2.5	4.0	3.65	3.8	2.5	3.9
15	4.8	4.0	6.8	5.3	2.65	3.15	2.5	4.15	4.15	4.3	2.35	3.4
16	4.3	3.9	6.7	4.9	2.8	3.0	2.6	5.7	3.85	3.9	2.35	3.1
17	3.9	3.9	6.6	4.5	2.95	2.7	2.6	6.15	3.4	3.4	2.25	3.0
18	3.9	3.8	6.45	4.25	3.2	2.45	2.35	4.9	3.05	2.9	2.2	2.6
19	3.9	3.8	[a] 6.0	4.1	3.05	2.35	2.15	4.0	3.0	2.65	2.15	2.5
20	3.7	3.7	12.86	3.9	3.05	2.25	2.0	3.45	3.05	3.0	2.05	2.4
21	3.65	3.6	15.71	3.7	2.85	2.4	1.85	3.25	3.1	3.6	2.0	2.7
22	3.65	3.6	15.56	3.65	2.7	3.5	1.7	2.95	3.6	4.75	1.9	4.1
23	3.35	3.6	13.85	3.6	2.6	4.65	1.6	2.65	3.2	4.95	1.9	4.75
24	3.3	3.6	11.75	4.0	2.45	6.1	1.7	2.4	2.9	4.4	1.8	5.25
25	3.0	3.55	11.72	4.6	2.35	6.2	1.65	2.5	2.8	3.9	1.8	5.75
26	[b] 2.9	3.6	14.05	4.2	2.25	5.3	1.75	3.6	2.55	3.5	1.7	5.3
27	[c] 4.35	[d] 3.5	13.62	3.9	2.1	4.5	1.6	2.9	2.3	3.25	1.7	4.7
28	4.8	3.65	12.68	3.6	2.1	3.8	1.8	2.65	2.1	3.0	1.7	4.1
29	4.8	.....	11.52	3.35	2.1	3.3	2.05	2.35	2.0	2.8	1.75	3.95
30	4.8	.....	10.42	3.25	2.0	2.95	2.0	2.1	1.9	2.65	2.9	4.2
31	4.8	.....	9.3	.....	1.95	.....	2.2	1.85	.....	2.5	.....	4.5

[a] March 19 ice went out.
[b] January 26 river frozen at gage; readings to top of ice.
[c] January 27 river frozen over.
[d] Open water at gage February 27 to March 11.

Station rating table for Susquehanna River at Harrisburg, Pa., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	6,550	3.50	29,430	7.00	86,600	12.00	190,500
1.10	7,090	3.60	30,800	7.20	90,400	12.20	195,100
1.20	7,650	3.70	32,200	7.40	94,200	12.40	199,800
1.30	8,240	3.80	33,600	7.60	98,000	12.60	204,600
1.40	8,850	3.90	35,000	7.80	101,800	12.80	209,400
1.50	9,520	4.00	36,400	8.00	105,600	13.00	214,200
1.60	10,200	4.10	37,800	8.20	109,400	13.20	219,000
1.70	10,930	4.20	39,200	8.40	113,200	13.40	223,900
1.80	11,700	4.30	40,700	8.60	117,100	13.60	228,900
1.90	12,500	4.40	42,200	8.80	121,100	13.80	233,900
2.00	13,300	4.50	43,800	9.00	125,100	14.00	238,900
2.10	14,160	4.60	45,400	9.20	129,100	14.20	243,900
2.20	15,050	4.70	47,100	9.40	133,100	14.40	249,100
2.30	15,980	4.80	48,600	9.60	137,200	14.60	254,300
2.40	16,950	4.90	50,250	9.80	141,400	14.80	259,500
2.50	17,960	5.00	51,900	10.00	145,600	15.00	264,700
2.60	19,010	5.20	55,100	10.20	149,800	15.20	269,900
2.70	20,100	5.40	58,400	10.40	154,200	15.40	275,300
2.80	21,210	5.60	61,700	10.60	158,600	15.60	280,700
2.90	22,340	5.80	65,000	10.80	163,000	15.80	286,100
3.00	23,480	6.00	68,400	11.00	167,500	16.00	291,500
3.10	24,620	6.20	71,900	11.20	172,100	16.50	305,200
3.20	25,760	6.40	75,500	11.40	176,700	17.00	319,200
3.30	26,910	6.60	79,200	11.60	181,300	17.50	333,500
3.40	28,130	6.80	82,900	11.80	185,900	18.00	348,000

NOTE.—The above table is applicable only for open-channel conditions. It is based on 44 discharge measurements made during 1897-1905. It is well defined throughout. Above gage height 18 feet the rating curve is practically a tangent, the difference being 3,000 per tenth. Below 7 feet the table is the same as for 1904.

Estimated monthly discharge of Susquehanna River at Harrisburg, Pa., for 1905.

[Drainage area, 24,030 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 1-25 [a]	143,500	23,480	55,550	2.31	2.15
March 19-31	283,700	68,400	199,100	8.28	4.00
April	111,300	26,340	50,430	2.10	2.34
May	24,620	12,900	18,810	.783	.903
June	71,900	11,700	26,910	1.12	1.25
July	25,190	10,200	16,300	.678	.781
August	71,020	12,100	23,010	.958	1.10
September	50,250	11,700	25,390	1.06	1.18
October	51,080	10,200	23,190	.965	1.11
November	22,340	10,930	15,360	.639	.713
December	194,600	16,950	58,120	2.42	2.79

[a] Ice conditions Jan. 26 to Mar. 18; no estimates.

SUSQUEHANNA RIVER AT M'CALL FERRY, PA.

This station was established May 17, 1902, by Boyd Ehle while investigating a power development. It is located at a narrow and rocky part of Susquehanna River, about 20 miles above its mouth and 1 mile above the village of McCall Ferry.

For a considerable distance along this portion of the river the bank on the York County shore is the retaining wall of an abandoned canal, which can be overtopped only in the greatest floods. The Lancaster shore, on the opposite side, is made up of almost equally vertical rock, and the railroad which skirts it has never yet been flooded at this point. The gaging section first selected for this station is located at Duncan Run, where two islands, Hartman and Streepers, divide the river into three channels ranging in width from 100 to 500 feet. At ordinary low water, however, two of these channels are dry and the discharge is confined to the main or westernmost channel. The river bed at this section is of mica-schistose rock, with some projecting bowlders and large irregularities. The flow, however, is comparatively free from the boils so common in a river of this character.

The discharge measurements at this station are made from a boat held in place by a rope stretched between the towpath and Streepers Island, the gaging points, 10 feet apart, being indicated by a tagged wire, which is also used in keeping the boat parallel to the stream.

In order to provide for measuring the large floods which occur in the winter and spring months, a cable station was established by Mr. Ehle in the fall of 1902 about 1,000 feet downstream from the Duncan Run section. The banks of the river and the conditions of the river bed are very similar to those at the upper section, the only difference being that the bed is somewhat more irregular. During the low-water period of the fall of 1902 a careful survey was made of the section at the cable station, and a contour map with 1-foot intervals was prepared, from which the effective areas could be accurately determined, thus eliminating the error in discharge due to possible inaccuracies in the soundings at the time of measurements. The width of the stream at this point is about 1,300 feet, and the maximum depth during a gaging was 46 feet.

The car cable, a three-fourths inch 37-wire strand with a span of 1,450 feet, is anchored to 3-inch eyebolts set in cement in the solid rock on either side of the river. A 2-inch turnbuckle is provided at the York County end, to regulate its height above the water. A high cliff on one shore and a large red oak on the other give the cable a 10-foot clearance over the highest floods on record. The car that runs on the cable accommodates two people and is propelled by a sheave provided with a crank. Eighty feet upstream from the main cable a five-eighths inch secondary cable is suspended, along which runs a trolley wire carrying a guy rope to hold the meter against the current. Measuring points for this section are 50 feet apart, and are indicated by red and white bands painted on the main cable, the intermediate distances being readily estimated by counting the revolutions of the sheaves.

The measurements at both of the above stations are referred to two permanent gages, designated Nos. 2 and 5. These are painted on the rock and give elevations directly above sea level. Gage No. 2 is about three-fourths of a mile below the village of McCall Fe ry, in the tailrace of the proposed power house, and has been read daily since June, 1902. The records in the following tables have been referred to this gage. Gage No. 5 is about 2 miles below McCall Ferry, at the foot of Cullys Falls, and is so located in order to be entirely out of the influence of the proposed dam. One of the purposes of such extensive preparations as have been made at this point is to obtain data for determining the coefficient of discharge over ogee-faced weirs under high heads.

The methods used in carrying on the work at the McCall Ferry station are practically those employed by the hydrographers of the United States Geological Survey. Every effort has been made to e'iminate any source of error, and vertical velocity-curve determinations were made wherever possible. At Duncan Run, in order to make these measurements, an 80-pound weight, with pulley and rope attached, was dropped to the bottom, so that the meter could be pulled down without being washed too far from the section. When the sur-

face velocity, or 0.6 method, was used, the results were reduced by coefficients determined from these vertical velocity-curves. At the cable station the secondary cable, with the aid of the guy rope, made it possible to get vertical velocity-curve measurements at much greater velocities and depths. A No. 12 telegraph wire was found to be more satisfactory at such times for holding the meter than the insulated cable ordinarily used, as it offered less resistance to the current, would allow the meter to sink deeper, and, being less bowed by the water, would show more accurately its depth below the surface. In this way vertical velocity-curves were obtained to depths of 20 feet and in currents of 10 feet per second. During the highest stages, when the velocity sometimes reaches 17 feet per second, readings could be taken only at the surface. These results were, however, reduced by coefficients determined from the vertical velocity-curve for each measuring point.

All records and estimates for this station for years prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Mean daily gage height, in feet, of Susquehanna River at McCall Ferry, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	122.4	116.6	116.6	126.9	119.7	116.5	117.9	117.1	116.6	116.3	117.6	119.2
2	121.2	116.1	116.7	125.2	119.0	116.3	117.6	116.8	116.5	116.0	117.2	123.0
3	121.0	116.9	116.8	124.6	118.2	116.3	117.4	116.5	116.8	116.1	117.0	123.4
4	120.5	117.0	116.8	123.6	117.9	116.3	117.1	116.3	117.0	116.0	117.0	126.2
5	119.3	116.6	117.0	122.7	117.7	116.2	117.0	116.3	118.4	115.9	117.0	132.0
6	119.8	116.0	116.9	122.2	117.7	116.1	118.1	116.5	121.0	115.9	117.0	130.9
7	122.6	116.1	117.3	122.9	117.7	116.2	118.7	116.6	119.7	115.9	117.1	127.0
8	128.4	116.4	117.5	122.2	117.6	116.6	118.3	117.0	119.7	116.0	117.0	124.7
9	127.0	116.2	118.3	122.6	117.6	116.9	117.7	116.9	121.2	116.1	117.05	123.1
10	123.8	116.0	119.5	122.4	117.4	118.6	117.3	116.6	120.0	116.2	117.2	122.5
11	123.2	116.2	119.9	122.1	117.3	118.9	118.6	116.2	119.0	115.9	117.2	121.3
12	122.0	116.2	121.9	121.6	117.3	119.1	118.5	116.5	118.8	116.8	117.4	120.8
13	121.3	116.4	122.0	121.5	117.4	118.7	118.1	116.8	119.1	117.0	117.7	120.3
14	120.9	116.4	121.5	121.8	117.4	118.5	117.6	117.7	119.5	119.4	117.6	119.9
15	120.5	116.1	121.0	122.3	117.3	118.4	117.9	119.9	119.4	119.9	117.3	119.5
16	120.0	115.8	120.9	121.7	117.7	118.3	118.0	120.6	120.0	120.1	117.0	118.4
17	119.6	116.0	120.6	121.2	118.0	118.1	117.9	123.0	119.6	119.5	117.0	118.2
18	119.1	116.3	120.6	120.8	118.3	117.7	117.5	122.4	118.8	118.6	116.9	118.1
19	119.0	116.0	124.5	120.5	118.5	117.4	117.2	120.7	118.3	118.1	116.8	117.7
20	119.3	115.9	132.5	120.0	118.3	117.1	116.9	119.9	118.3	118.0	116.8	117.5
21	119.0	115.6	136.0	119.8	118.2	117.0	116.5	118.8	118.2	119.2	116.6	117.85
22	119.0	115.6	137.8	119.6	117.9	117.0	116.2	118.6	118.5	120.0	116.3	120.7
23	119.2	115.5	134.9	119.3	117.7	119.3	116.1	118.1	118.9	120.7	116.2	120.9
24	118.7	115.7	132.4	119.5	117.4	120.5	116.0	117.6	118.3	121.0	116.1	121.6
25	118.1	115.6	131.5	120.6	117.2	123.0	115.9	117.9	118.1	120.2	115.9	122.0
26	117.5	116.0	134.6	120.5	117.0	122.3	116.0	122.0	117.8	119.6	115.8	122.3
27	116.9	116.5	133.7	120.1	116.8	121.1	115.9	120.0	117.5	119.1	115.8	121.6
28	116.3	116.5	132.8	119.7	116.7	120.0	115.8	119.1	117.1	118.7	115.75	120.8
29	116.5	.....	131.4	119.3	116.6	119.3	115.9	118.0	116.8	118.4	116.0	120.0
30	116.4	.....	130.5	119.0	116.6	118.5	115.9	118.5	116.5	118.1	118.1	120.5
31	116.0	.....	128.6	.....	116.5	.....	116.4	117.0	.....	117.8	.....	120.3

NOTE.—There was little or no ice near the gage during the winter months, so that the flow was not modified appreciably.

Station rating table for Susquehanna River at McCall Ferry, Pa., from June 1, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
114.00	5,100	115.70	12,060	117.60	22,560	122.00	59,000
114.10	5,500	115.80	12,540	117.80	23,820	122.50	65,300
114.20	5,840	115.90	13,040	118.00	25,110	123.00	71,500
114.30	6,200	116.00	13,540	118.20	26,430	124.00	84,200
114.40	6,560	116.10	14,040	118.40	27,780	125.00	98,600
114.50	6,930	116.20	14,560	118.60	29,140	126.00	112,900
114.60	7,310	116.30	15,080	118.80	30,500	127.00	127,000
114.70	7,700	116.40	15,610	119.00	31,900	128.00	141,100
114.80	8,100	116.50	16,150	119.20	33,300	129.00	155,300
114.90	8,500	116.60	16,690	119.40	34,700	130.00	172,500
115.00	8,920	116.70	17,240	119.60	36,100	131.00	194,100
115.10	9,340	116.80	17,800	119.80	37,500	132.00	217,300
115.20	9,770	116.90	18,360	120.00	39,100	133.00	240,000
115.30	10,210	117.00	18,930	120.50	43,300	134.00	262,000
115.40	10,660	117.20	20,120	121.00	48,000	135.00	285,300
115.50	11,120	117.40	21,320	121.50	53,200	136.00	309,300
115.60	11,580						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 37 discharge measurements made during 1902–1904, inclusive. It is well defined throughout.

Estimated monthly discharge of Susquehanna River at McCall Ferry, Pa., for 1905.

[Drainage area, 26,770 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	146,900	13,540	45,170	1.69	1.95
February	18,930	11,120	14,320	.535	.557
March	352,900	16,690	116,300	4.34	5.00
April	125,600	31,900	56,150	2.10	2.34
May	36,800	16,150	22,920	.856	.987
June	71,500	14,040	27,850	1.04	1.16
July	29,820	12,540	20,190	.754	.869
August	71,500	14,560	28,360	1.06	1.22
September	50,000	16,150	29,040	1.08	1.20
October	48,000	13,040	25,730	.961	1.11
November	25,770	12,300	18,200	.680	.759
December	217,300	21,940	61,930	2.31	2.66
The year	352,900	11,120	38,850	1.45	19.83

CHENANGO RIVER AT BINGHAMTON, N. Y.

Chenango River rises in central Madison County, N. Y., in the towns of Eaton and Madison, flows southward, and unites with the Susquehanna at Binghamton. Its headwater valleys lie at an elevation of about 1,200 feet above tide. The elevation of its mouth above tide is 864 feet. Its length is approximately 70 miles, and its drainage area is 1,580 square miles.

The gaging station, which was established July 31, 1901, is located at the Court Street Bridge, Binghamton.

The bridge to which the gage is attached stands squarely across the stream at a point where there is a good bed of gravel and small cobblestones and a smooth, uniform current. The channel is obstructed by three masonry piers supporting the four spans of the bridge, 79 feet clear width each, the bridge having a total length of 337 feet between abutments. A small rift between the station and the confluence of Chenango River with the Susquehanna, about 2,500 feet below, cuts off backwater at ordinary stages of the rivers. For periods during freshets or at times when there is an abnormal rise on one or both streams, either record may be affected by backwater and too great a discharge indicated.

A standard chain gage is attached to the hand rail of the bridge on the upstream side of the first span from the right bank. The gage is read by William Ray Monroe. The bench mark is a circular chisel draft on the upstream corner of the bridge seat on the left abutment. Its elevation is 34.02 feet above gage datum.

In estimating the run-off of Chenango River the area directly tributary to storage reservoirs, from which diversion is made to supply Erie Canal, has been deducted from the total natural drainage area. The diversion area of six reservoirs at the head of Chenango River, whose outflow is turned into Erie Canal through Oriskany Creek, is 30 square miles. The diversion area of De Ruyter reservoir, at the head of Tioughnioga River, whose outflow is turned into Erie Canal through Limestone Creek, is 18 square miles. These two areas have been subtracted from the natural drainage area of 1,580 square miles, giving an effective area of 1,532 square miles. This estimate is approximate, as no allowance for direct inflow to feeder channels from additional areas, nor for waste into the original stream, has been made. The gross area from which more or less run-off is diverted is about 105 square miles.

All estimates and records for this station for years prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Chenango River at Binghamton, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 16	H. R. Beebe	305	770	2.22	6.37	1,706
August 19	C. C. Covert	320	844	1.83	6.42	1,545
August 25	E. F. Weeks	290	566	1.29	5.64	728

Mean daily gage height, in feet, of Chenango River at Binghamton, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1....	8.32	6.2	5.37	12.56	6.55	5.65	6.12	6.82	8.05	5.95	6.38	8.78
2....	8.45	6.23	5.57	10.68	6.43	5.55	6.28	6.75	7.12	5.88	6.8	7.28
3....	8.85	6.07	5.49	9.44	6.38	5.58	6.75	6.15	7.42	6.38	6.48	12.92
4....	7.09	5.97	5.41	8.76	6.31	5.6	6.6	5.98	10.92	7.12	6.35	14.70
5....	6.82	5.93	5.47	10.36	6.23	5.62	6.38	5.82	14.72	6.5	6.28	11.55
6....	6.92	5.93	5.39	10.96	6.55	8.15	6.35	5.72	13.1	6.22	6.25	9.42
7....	9.39	5.9	5.57	10.86	6.51	7.22	6.12	5.72	9.9	6.05	7.65	8.55
8....	10.55	5.87	5.47	10.0	6.42	6.88	6.1	6.12	8.62	5.95	7.25	8.18
9....	9.12	5.77	5.46	9.1	6.27	6.68	6.02	5.88	7.78	5.88	7.22	7.90
10....	8.22	5.72	5.56	8.63	6.32	6.3	5.92	5.75	7.22	5.85	6.98	7.78
11....	7.42	5.74	5.7	8.8	6.17	6.1	5.82	5.7	6.88	5.88	6.82	7.50
12....	7.26	5.66	5.66	9.67	6.12	6.3	5.75	5.8	9.85	9.65	6.75	7.22
13....	7.98	5.72	5.63	9.13	6.1	6.2	5.72	6.18	8.98	9.22	6.65	7.12
14....	7.98	5.86	5.76	8.37	6.07	6.3	5.85	6.15	7.98	7.68	6.65	6.95
15....	7.18	5.74	5.63	8.05	6.27	6.02	5.98	5.95	7.18	7.15	6.58	6.58
16....	6.91	6.25	5.76	8.07	6.3	5.85	6.48	6.42	6.92	6.85	6.5	6.12
17....	6.74	5.68	5.5	7.8	6.21	5.78	6.1	7.38	6.9	6.65	6.38	6.18
18....	6.58	5.6	5.78	7.69	6.25	6.02	5.92	7.0	8.08	6.52	6.3	6.25
19....	6.74	5.65	8.87	7.49	6.28	6.90	5.82	6.35	8.58	7.08	6.22	6.32
20....	6.46	5.6	12.42	7.22	6.28	7.05	5.8	6.08	7.78	7.55	6.12	6.32
21....	6.34	5.6	13.55	7.74	6.1	6.95	5.72	5.95	8.12	7.45	5.98	6.68
22....	6.34	5.5	12.79	8.86	6.0	12.32	5.65	5.9	7.68	6.95	5.92	9.42
23....	6.18	5.52	12.17	8.04	5.92	11.15	5.58	5.85	7.02	6.8	5.9	9.35
24....	6.04	5.4	11.97	7.54	5.85	9.12	6.88	5.72	6.7	6.68	5.85	8.40
25....	6.36	5.48	16.45	7.19	5.75	7.78	6.72	5.55	6.48	6.58	5.9	7.58
26....	6.61	5.25	18.45	6.99	5.75	7.1	6.12	5.52	6.35	6.48	5.98	7.38
27....	6.5	5.54	17.55	6.84	6.08	6.95	5.82	5.48	6.2	6.32	5.85	7.08
28....	6.55	5.47	17.22	6.65	6.02	6.75	5.7	5.45	6.1	6.25	5.9	6.85
29....	6.65	.....	15.54	6.53	5.88	6.52	5.65	5.45	6.05	6.18	7.95	7.12
30....	6.63	.....	14.21	6.73	5.75	6.30	5.75	5.48	6.0	6.12	10.8	8.95
31....	6.33	.....	13.81	.....	5.7	.....	6.82	7.58	.....	6.08	.....	8.12

NOTE.—During the entire frozen period there was an open channel of varying width at the gage. From January 26 to February 20, approximately, the river was frozen entirely across a short distance below the gage. The ice finally broke up March 18. Gage heights interpolated November 15 to 18, inclusive.

Station rating table for Chenango River at Binghamton, N. Y., from August 1, 1901, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.00	160	7.10	2,750	9.40	6,420	13.60	14,460
5.10	256	7.20	2,900	9.60	6,780	13.80	14,880
5.20	352	7.30	3,050	9.80	7,140	14.00	15,300
5.30	450	7.40	3,200	10.00	7,500	14.20	15,720
5.40	550	7.50	3,350	10.20	7,860	14.40	16,140
5.50	650	7.60	3,500	10.40	8,220	14.60	16,560
5.60	760	7.70	3,650	10.60	8,590	14.80	16,980
5.70	875	7.80	3,800	10.80	8,970	15.00	17,400
5.80	995	7.90	3,950	11.00	9,350	15.20	17,820
5.90	1,115	8.00	4,100	11.20	9,730	15.40	18,240
6.00	1,235	8.10	4,250	11.40	10,110	15.60	18,660
6.10	1,365	8.20	4,400	11.60	10,490	15.80	19,080
6.20	1,495	8.30	4,550	11.80	10,870	16.00	19,500
6.30	1,625	8.40	4,700	12.00	11,250	16.20	19,940
6.40	1,755	8.50	4,850	12.20	11,650	16.40	20,380
6.50	1,885	8.60	5,020	12.40	12,050	16.60	20,820
6.60	2,025	8.70	5,190	12.60	12,450	16.80	21,260
6.70	2,165	8.80	5,360	12.80	12,850	17.00	21,700
6.80	2,305	8.90	5,530	13.00	13,250	18.00	23,950
6.90	2,450	9.00	5,700	13.20	13,650	19.00	26,300
7.00	2,600	9.20	6,060	13.40	14,050		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1905. It is well defined between gage heights 5 feet and 9 feet. The table has been extended above 9 feet, being based on one measurement at 19.8 feet.

Estimated monthly discharge of Chenango River at Binghamton, N. Y., for 1905.

[Drainage area, 1,532 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January (1–25) [a]	8,495	1,287	3,335	2.18	2.03
March (19–31)	24,980	5,479	15,950	10.42	5.03
April	12,370	1,927	5,120	3.35	3.74
May	1,955	875	1,442	.942	1.09
June	11,890	705	2,593	1.69	1.89
July	2,420	738	1,347	.880	1.01
August	3,470	600	1,339	.875	1.01
September	16,810	1,235	4,351	2.84	3.17
October	6,870	1,055	2,237	1.46	1.68
November	8,970	1,055	2,124	1.39	1.55
December	16,770	1,391	4,431	2.90	3.34

[a] Ice conditions January 26 to March 18; no estimate made.

CHEMUNG RIVER AT CHEMUNG, N. Y.

Chemung River is formed at Painted Post, N. Y., by the confluence of Tioga and Cohocton rivers. Cohocton River lies entirely in the State of New York. Tioga River receives, just above its mouth, Canisteo River, a large tributary, which also has its drainage basin in New York to the south of the Cohocton. The drainage area of Tioga River above the Canisteo is mainly in Pennsylvania. Chemung River flows southeastward through Corning, Elmira, and Chemung, crosses the State line and flows for a short distance in Pennsylvania, then returns to New York, and crosses again to Pennsylvania near Waverly, finally emptying into the Susquehanna near Athens, Bradford County, Pa. The total length of the river is about 40 miles, of which 30 miles lie in New York; the drainage area, measured at the mouth, is 2,520 square miles.

The topographic features of the basin are as a rule bold and broad. The hills rise to a height of several hundred feet on either side, within a short distance of the stream. The upland plateau is to a large extent wooded, has impervious soil, no lake storage, and few marsh areas. Tributaries are ramifying and uniformly distributed, though not very numerous, and dry gullies or flood channels are common. The main river is sluggish, with low banks and a broad valley or flood plain which is often overflowed. The concentration of storm waters from the three large streams which unite just above Corning makes possible excessive floods. Dikes have been erected in the cities of Elmira and Corning for protection. One of the highest recorded freshets in the stream occurred June 1, 1889. It was preceded by phenomenal rainfall, aggregating several inches in a few hours during the night of May 31. The discharge at this time has been estimated at 67 second-feet per square mile from 2,055 square miles, or 138,000 second-feet.[a]

The gaging station was established September 7, 1903, by R. E. Horton. It is located at the suspension highway bridge, midway between Chemung, N. Y., and Willawana, Pa., near the State line.

The channel is straight for 700 feet above and 800 feet below the station. The right bank is high, cleared, and not subject to overflow; the left bank is of medium height, wooded, and will overflow at high water. The bed of the stream is composed of gravel and is clean and permanent. The current is good. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the bridge, which has a single span of 395 feet. The initial point for soundings is the face of the right abutment on the downstream side.

A standard chain gage is attached to the upstream side of the bridge, near the right bank, and is read twice each day by Daniel L. Orcutt. The bench mark is formed by three nails driven into a telephone pole 70 feet to the right of the initial point for soundings and about 30 feet upstream. The pole is marked with black paint "U. S. G. S. B. M." Elevation of bench mark above gage datum, 29.88 feet.

All records and estimates for this station for years prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Chemung River at Chemung, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 21	F. H. Brundage	391	3,381	4.87	9.46	16,480
March 22	do	389	3,412	4.87	9.49	16,630
March 22	do	389	3,094	4.48	8.84	13,860
March 26	W. B. Freeman	393	4,462	6.58	12.10	29,340
March 26	do	393	4,194	6.16	11.39	25,860
May 18	H. R. Beebe	220	1,040	.69	2.64	714
July 20	Murphy and Covert	216	1,060	.75	2.62	748
August 23	Covert and Weeks	197	904	.49	2.28	435

[a] Report of Francis Collingwood, C. E., on the protection of the city of Elmira, N. Y., against floods.

Mean daily gage height, in feet, of Chemung River at Chemung, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.64	2.93	3.0	5.95	3.38	2.3	3.05	3.1	1.9	1.86	2.26	3.58
2	3.56	2.93	3.05	5.2	3.2	2.05	3.45	2.95	2.04	1.85	2.34	2.88
3	3.14	2.88	3.0	4.75	3.2	2.25	5.02	2.75	2.08	1.96	2.55	4.95
4	2.79	2.83	2.95	4.5	3.05	2.3	3.8	2.5	2.08	2.02	2.46	6.16
5	2.54	2.75	3.02	4.55	2.8	2.15	3.35	2.5	2.04	2.2	2.44	4.86
6	3.04	2.65	3.1	4.78	2.8	2.3	3.15	2.38	2.04	2.03	2.5	4.32
7	4.09	2.63	3.08	5.0	2.82	2.35	2.95	2.32	2.02	1.88	2.46	4.02
8	5.74	2.63	3.25	4.7	2.95	3.3	2.82	2.3	1.96	1.86	2.83	3.94
9	4.59	2.63	3.45	4.45	2.82	3.18	2.9	2.25	1.96	1.87	2.76	4.09
10	4.09	2.72	3.85	4.22	2.68	2.95	3.0	2.3	1.9	1.86	2.76	4.21
11	3.76	2.72	3.9	4.7	2.6	2.8	2.95	2.22	1.9	1.84	2.68	4.02
12	3.49	2.72	3.88	5.22	2.58	2.85	2.65	2.65	2.24	2.9	2.6	3.67
13	3.34	2.72	3.9	4.78	2.7	3.0	2.72	4.05	2.58	3.0	2.5	3.48
14	3.39	2.72	3.9	4.22	2.68	2.9	2.75	3.1	2.72	2.71	2.42	3.33
15	4.44	2.87	3.8	4.2	2.7	2.9	2.92	2.88	2.6	2.5	2.43	2.97
16	5.04	2.91	3.82	4.5	2.75	2.75	2.92	2.75	2.57	2.42	2.4	2.56
17	5.69	2.95	4.1	4.35	2.7	2.7	2.8	2.85	2.56	2.36	2.38	2.66
18	5.09	2.9	7.3	4.2	2.65	3.45	2.65	2.82	2.7	2.16	2.32	2.76
19	4.64	2.88	13.6	4.12	2.6	7.1	2.9	2.65	2.51	2.19	2.34	2.72
20	3.58	2.8	14.1	3.98	2.6	6.05	2.55	2.58	2.58	2.54	2.24	2.68
21	3.23	2.8	9.48	4.08	2.58	5.05	2.4	2.4	2.38	2.87	2.18	3.26
22	2.98	2.95	9.3	5.95	2.5	10.55	2.2	2.4	2.26	2.9	2.1	7.05
23	2.68	3.0	9.6	5.1	2.5	7.88	2.12	2.33	2.19	2.77	2.14	6.32
24	2.63	3.0	11.6	4.52	2.35	5.9	3.2	2.16	2.08	2.62	2.22	5.74
25	2.73	3.0	13.2	4.2	2.4	5.08	2.9	2.08	2.04	2.58	2.17	4.54
26	2.48	3.0	11.9	4.0	2.35	4.4	2.8	2.02	2.0	2.5	2.08	4.13
27	2.83	3.0	10.35	3.85	2.4	3.88	2.65	1.94	1.86	2.49	2.1	3.84
28	2.93	3.0	9.9	3.7	2.2	3.68	2.4	1.91	1.9	2.44	2.08	3.58
29	3.08	.....	8.52	3.55	2.4	3.45	2.42	1.97	1.92	2.32	2.61	4.18
30	2.93	.....	7.6	3.5	2.3	3.25	3.45	1.94	1.86	2.32	4.02	6.68
31	2.93	.....	6.6	.....	2.25	.....	3.45	1.9	.....	2.24	.....	4.74

NOTE.—River frozen entirely across January 16 to March 18, approximately, except for open water at the rapids below the station. The gage heights are to the surface of the water in a hole cut in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.
	Feet.	*Feet.*
January 28	2.93	3.13
February 4	2.83	3.13
February 11	2.72	3.02
February 18	2.9	3.0
February 26	3.0	3.2
March 4	2.95	3.05
March 11	3.9	4.0

WEST BRANCH SUSQUEHANNA RIVER AT WILLIAMSPORT, PA.

The West Branch of the Susquehanna rises in the mountains of Cambria County, Pa., at an elevation of not less than 2,000 feet above sea level, flows northeast, then southeast, and unites with the main stream above Sunbury. Its total length is about 425 miles and its drainage area is approximately 7,030 square miles.

The topography of the basin is rugged, the banks of the main stream and tributaries are generally high, and there are few low grounds subject to overflow. The fall is variable, but is much greater above Queens Run than below, where the river traverses a wide, fertile, well-cultivated valley. Facilities for artificial storage are probably good, and the flow of many of the tributaries might no doubt be regulated to considerable extent. The river is navigable, by means of the canal along its banks, to Lock Haven and beyond.

The gaging station at Williamsport was established March 1, 1895, by George D. Snyder, who was at that time city engineer, and daily gage heights have been recorded since that date. It is located at the Market Street Bridge. A standard chain gage was installed on August 16, 1901, by E. G. Paul.

The channel is about 1,000 feet wide at the station, is broken by four bridge piers, and is straight for several hundred feet above and below. There is a dam about one-half mile above. Both banks are high and rocky. The bed of the stream is composed of gravel and silt, and will probably change to some extent in the shore spans. The current velocity is sufficient for accurate measurements except at extreme low stages.

Discharge measurements are made from the upper side of the bridge to which the gage is attached. The initial point for soundings is the face of the abutment on the left bank.

A standard chain gage is attached to the upper side of the bridge. The length of the chain from the end of the weight to the marker is 40.29 feet. The gage is read once each day by Henry H. Guise, who is employed in the city engineer's office. The bench mark is a cut in the face of the left abutment of the bridge, 10.07 feet above the gage datum.

During nearly eleven years, from March, 1895, to January, 1906, the range of gage height at this station has been 21.3 feet, and the estimated maximum and minimum discharges have been 164,100 and 410 second-feet, respectively.

All records and estimates for this station prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of West Branch Susquehanna River at Williamsport, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 22	H. D. Comstock	935	16,580	5.23	15.82	86,780
March 22	do	935	16,190	*5.09	15.47	82,350
March 23	do	935	13,480	4.30	12.64	57,960
March 23	do	935	14,190	4.38	13.33	62,150
March 24	do	935	12,150	3.81	11.05	46,250
March 25	do	935	12,050	3.64	10.98	43,930
March 28	G. F. Harley	935	11,140	3.57	10.12	39,730
March 31	do	935	8,022	2.78	6.92	22,330
July 7	Grover and Biggi	783	3,976	1.05	2.25	4,179

Mean daily gage height, in feet, of West Branch Susquehanna River at Williamsport, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	2.9	2.2	6.3	3.2	1.7	2.2	2.2	1.3	0.7	2.3	9.0
2	3.6	2.9	2.2	5.5	2.9	1.7	2.0	2.2	1.2	.7	2.4	6.9
3	3.7	2.8	2.4	4.8	2.7	1.6	2.2	1.6	1.3	1.2	2.5	8.4
4	4.4	2.6	2.4	4.4	2.5	1.7	2.2	1.5	2.8	1.3	2.5	16.8
5	4.0	2.4	2.4	4.2	2.4	1.7	2.5	1.3	2.1	1.8	2.3	12.6
6	4.0	2.2	2.3	4.1	2.3	1.6	2.4	1.4	1.8	1.5	2.3	9.3
7	5.8	2.2	2.3	4.2	2.3	1.8	2.3	2.1	1.4	1.4	2.5	7.5
8	9.7	2.2	2.4	4.0	2.5	3.1	2.2	2.2	1.2	1.1	3.0	6.3
9	8.0	2.0	2.8	3.8	2.5	4.2	6.5	1.8	1.1	1.0	3.6	5.5
10	6.8	1.9	3.8	3.7	2.6	4.5	4.8	1.5	.9	.9	3.6	4.8
11	5.5	2.1	6.7	3.6	2.4	3.7	3.7	1.3	.9	1.0	3.0	4.3
12	6.2	2.1	6.1	4.6	2.4	3.9	3.4	2.3	1.9	2.9	2.7	4.0
13	5.6	1.9	5.6	6.0	2.7	4.5	2.9	4.9	3.1	3.6	2.7	3.8
14	6.1	1.8	4.9	5.5	3.4	4.3	3.3	4.7	3.5	4.0	2.6	3.4
15	6.7	2.2	4.8	5.0	3.5	3.8	3.7	4.1	2.8	3.2	2.5	3.0
16	6.1	2.2	4.5	4.6	3.8	3.3	3.5	5.9	2.2	2.8	2.4	2.3
17	5.4	2.2	4.3	4.3	4.2	3.0	3.1	5.7	1.8	2.5	2.3	2.0
18	4.9	2.1	5.2	3.9	4.0	2.7	2.6	4.5	2.0	2.3	2.2	2.1
19	5.5	1.9	13.2	3.6	3.8	2.6	2.3	3.7	2.5	2.2	2.1	2.2
20	5.3	1.9	18.4	3.4	3.4	2.7	2.0	3.0	2.4	2.8	2.0	2.4
21	5.2	1.8	16.7	3.3	3.2	3.8	1.8	2.6	2.3	6.4	1.9	2.8
22	4.8	1.8	15.9	3.7	3.0	6.0	1.6	2.3	2.0	6.6	1.8	4.8
23	4.2	1.7	13.6	5.1	2.7	5.9	1.6	2.1	1.8	5.6	1.6	5.7
24	4.0	1.7	10.9	5.4	2.5	5.8	1.7	1.9	1.6	4.7	1.6	5.8
25	4.0	1.7	10.9	4.9	2.3	5.0	1.7	2.0	1.4	4.1	1.6	5.4
26	4.0	1.8	11.7	4.5	2.2	4.4	1.8	2.1	1.3	3.7	1.6	4.9
27	3.8	1.8	10.9	4.1	2.2	3.8	1.5	2.2	1.1	3.3	1.7	4.5
28	3.3	2.1	10.1	3.9	2.1	3.3	1.3	2.0	1.0	3.0	1.6	4.3
29	3.0	.....	10.2	3.7	2.0	2.8	1.3	1.7	.9	2.7	2.1	4.0
30	2.7	.....	8.1	3.4	1.8	2.5	1.5	1.5	.8	2.5	7.4	5.8
31	3.0	.....	7.2	.....	1.8	.....	1.6	1.4	.....	2.3	.....	7.0

NOTE.—River frozen January 15 to March 18. During this period the gage was read to the top of ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 15	2.1	2.2	1.0
February 20	1.8	1.9	1.0
February 27	1.8	1.8	.5

Station rating table for West Branch Susquehanna River at Williamsport, Pa., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−0.20	410	2.20	4,530	5.80	17,150	10.20	40,380
0.00	600	2.30	4,770	6.00	18,060	10.40	41,600
0.10	710	2.40	5,010	6.20	18,980	10.60	42,840
0.20	830	2.50	5,250	6.40	19,940	10.80	44,120
0.30	970	2.60	5,500	6.60	20,900	11.00	45,400
0.40	1,120	2.70	5,760	6.80	21,900	11.20	46,700
0.50	1,280	2.80	6,020	7.00	22,900	11.40	48,050
0.60	1,440	2.90	6,300	7.20	23,900	11.60	49,450
0.70	1,610	3.00	6,580	7.40	24,900	11.80	50,900
0.80	1,780	3.20	7,170	7.60	25,920	12.00	52,400
0.90	1,960	3.40	7,780	7.80	26,960	12.20	53,900
1.00	2,140	3.60	8,400	8.00	28,000	12.40	55,450
1.10	2,320	3.80	9,030	8.20	29,080	12.60	57,050
1.20	2,510	4.00	9,690	8.40	30,160	12.80	58,650
1.30	2,700	4.20	10,400	8.60	31,240	13.00	60,300
1.40	2,890	4.40	11,150	8.80	32,340	13.20	62,000
1.50	3,080	4.60	11,940	9.00	33,460	13.40	63,700
1.60	3,270	4.80	12,750	9.20	34,580	13.60	65,500
1.70	3,460	5.00	13,600	9.40	35,700	13.80	67,300
1.80	3,660	5.20	14,470	9.60	36,840	14.00	69,100
1.90	3,860	5.40	15,350	9.80	38,000	14.50	73,650
2.00	4,070	5.60	16,250	10.00	39,180	15.00	78,400
2.10	4,300						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1905. It is well defined between gage heights 1.4 feet and 16 feet. The table has been extended beyond these limits. The only low-water measure taken in 1905 is 12 per cent less than the curve. The lower part of the curve is so well defined by measurements of previous years that the table of 1904 has been used below 5 feet.

Estimated monthly discharge of West Branch Susquehanna River at Williamsport, Pa., for 1905.

[Drainage area, 5,640 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January (1–14)[a]	37,420	8,400	16,480	2.92	1.52
March (19–31)	111,100	23,900	56,810	10.07	4.87
April	19,460	7,470	11,320	2.01	2.24
May	10,400	3,660	6,029	1.07	1.23
June	18,060	3,270	8,256	1.46	1.63
July	20,420	2,700	5,622	.997	1.15
August	17,600	2,700	5,985	1.06	1.22
September	8,090	1,780	3,682	.653	.729
October	20,900	1,610	6,541	1.16	1.34
November	24,900	3,270	5,550	.984	1.10
December	96,560	4,070	18,320	3.25	3.75

[a] River frozen January 15 to March 18 inclusive; no estimates.

JUNIATA RIVER AT NEWPORT, PA.

Juniata River rises in the mountains of Bedford, Blair, and Somerset counties, Pa., at a general elevation of 2,000 feet above the sea, though the divide between its waters and those of the Ohio attains in places an elevation of 2,800 feet. The river has two chief upper divisions, the Frankstown and Raystown branches. From their union, a few miles southeast of Huntington, the main river winds eastward to the point where it enters the Susquehanna at Duncans Island. The length below the branches is about 75 miles. The total drainage area, measured at the mouth, is 3,530 square miles.

The valley of the main river is very narrow and the banks are generally high, with few low grounds to be overflowed. As a rule the bed is of gravel or sand, often with rock at very small depth and sometimes at the surface. The whole basin is traversed from southwest to northeast by a number of parallel ranges, across and between which the river and its tributaries wind. There are no lakes in the region, but facilities for artificial storage are good. The Pennsylvania Railroad follows the main river, Frankstown Branch, and the Little Juniata almost to the summit of the mountains.

The gaging station was established March 21, 1899, by E. G. Paul. Until the autumn of 1904 it was located on the covered wagon bridge 800 feet east of the public square at Newport, Pa. In the latter part of 1904 this bridge was removed and a steel structure erected on the same site.

The channel is straight for one-half mile above and below the station. Both banks are high and are not subject to overflow. There is a single channel broken by three bridge piers. The piers do not interfere with the flow of the stream, and there is little eddying and boiling near them. The bed is of hard material and is probably permanent. There is a good measurable velocity at all stages.

Discharge measurements are made from the lower side of the bridge to which the gage is attached. The initial point for soundings is the end of the hand rail on the right bank, downstream side of the bridge.

On March 29, 1905, a standard chain gage was attached to the hand rail on the lower side of the new bridge in the first span from the right bank. The length of the chain from the end of the weight to the marker is 36.81 feet. The gage is read once each day by N. M. Eyth. Bench mark No. 1 is on the extreme east end of the stone doorsill, east front of Ewing's store building, near end of bridge. The elevation above gage datum is 28.83 feet. Bench mark No. 2 is on shelf in southeast corner of underpinning of store of J. M. Ewing; elevation above gage datum, 27.37 feet. This is a bench mark of the Pennsylvania Railroad, and according to its levels is 390.69 feet above sea level.

During nearly seven years the range in gage height has been 22.8 feet, and the estimated maximum and minimum discharge has been 292,500 and 230 second-feet, respectively.

All records and estimates for this station for years prior to 1905 have been revised and republished in Water-Supply Paper No. 109.

Discharge measurements of Juniata River at Newport, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 24	Robert Follansbee	608	4,012	4.14	8.56	16,630
March 27	do	608	3,730	4.47	8.20	16,690
March 29	do	576	2,509	3.91	6.23	9,805
April 1	H. M. Morse	575	2,182	3.49	5.68	7,605
April 4	G. F. Harley	550	1,464	2.78	4.39	4,068
July 4	N. C. Grover	512	1,113	2.04	3.70	2,271
July 6	Grover and Biggi	512	1,057	1.80	3.48	1,901

Mean daily gage height, in feet, of Juniata River at Newport, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	4.7	4.3	5.2	3.8	3.7	3.5	3.5	3.6	3.0	3.6	5.7
2	4.3	4.7	4.3	5.1	3.6	3.9	3.5	3.5	3.6	3.2	3 6	5.9
3	4.5	4.7	4.3	5.1	3.6	3.9	3.5	3.6	3.6	3.2	3.6	7.6
4	4.6	4.7	4.3	4.5	3.5	3.7	3.6	3.5	4.9	3.2	3.6	7.4
5	4.6	4.5	4.3	4.3	3.5	3.7	3.7	3.5	4.7	3.2	3.6	7.0
6	4.6	4.5	4.3	4.4	3.5	3.6	3.6	3.4	4.3	3.2	3.6	7.0
7	5.2	4.5	4.5	4.5	3.5	4.2	3.6	3.4	4.0	3.2	3.5	5 9
8	7.8	4.4	5.1	4.4	3.6	6.3	3.6	3.2	3.6	3.4	3.5	4.6
9	6.8	4.4	5.2	4.3	3.6	5.9	3.6	3.2	3.6	3.4	3.5	4.6
10	6.2	4.4	7.1	4.4	3.5	5.9	3.6	3.4	3.6	3.6	3.5	4.6
11	6.2	4.4	12.2	4.3	3.5	5.1	3.7	3.7	3.9	3.8	3.5	4.6
12	6.2	4.2	7.2	4.3	3.5	4.9	3.7	4.0	4.2	3.8	3.5	4.5
13	5.7	4.1	6.2	4.5	3.6	4.3	3.7	4.2	4.7	3.8	3.4	4.2
14	5.7	4.1	5.3	4.6	3.7	4.3	3.7	4.6	4.3	3.8	3.9	4.0
15	6.2	4.1	5.2	4.6	4.1	4.1	3.7	6.35	4.3	3.8	3.4	3.8
16	6.2	4.1	5.2	4.3	4.5	4.0	3.7	10.0	4.0	3.6	3.4	3.8
17	6.2	4.1	5.2	4.3	4.7	4.0	3.7	8.0	3.8	3.6	3.4	3.8
18	6.2	4.1	5.3	4.2	4.5	4.0	3.7	5.0	3.8	3.6	3.4	3.8
19	6.0	4.1	8.6	4.2	4.5	4.0	3.6	4.6	3.7	4.0	3.4	4.2
20	6.0	4.1	10.2	4.2	4.5	4.0	3.6	4.0	3.7	4.7	3.4	4.2
21	5.9	4.1	11.2	4.2	4.1	3.9	3.4	4.0	2.8	4.9	3.3	5.3
22	5.2	4.1	11.7	4.2	4.0	3.9	3.4	3.8	2.6	4.9	3.8	6.4
23	5.2	4.1	10.2	4.0	3.8	3.9	3.3	4.9	2.6	4.9	3.2	6.4
24	5.2	4.1	10.2	3.9	3.7	3.8	3.3	4.8	2.8	4.7	3.2	4.8
25	5.4	4.1	9.2	3.8	3.5	4.1	3.3	4.8	2.8	4.7	3.2	4.8
26	5.9	4.3	9.2	3.8	3.5	3.7	3.6	4.8	2.8	4.6	3.2	4.6
27	5.9	4.3	7.2	3.8	3.5	3.7	3.6	4.8	2.8	4.5	3.2	4.6
28	4.9	4.3	6.2	3.8	3.5	4.1	3.4	4.7	2.7	4.5	3.9	4.6
29	4.9	.....	6.0	3.8	3.5	4.1	3.6	4.5	2.7	4.0	4.3	5.1
30	4.9	.....	5.8	3.8	3.5	3.9	3.7	4.0	2.7	3.8	5.6	5.4
31	4.7	.....	5.2	.....	3.7	.....	3.3	3.6	.....	3.8	.....	.....

NOTE.—January 8, ice gorge below causing backwater. February 12–March 8, river frozen at gage. Readings to top of ice.
Gage height interpolated July 15 and August 12.

Station rating table for Juniata River at Newport, Pa., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	230	4.30	3,870	6.10	9,210	8.80	19,120
2.60	320	4.40	4,130	6.20	9,540	9.00	19,940
2.70	430	4.50	4,400	6.30	9,870	9.20	20,780
2.80	570	4.60	4,670	6.40	10,200	9.40	21,620
2.90	750	4.70	4,950	6.50	10,540	9.60	22,460
3.00	950	4.80	5,230	6.60	10,880	9.80	23,300
3.10	1,160	4.90	5,520	6.70	11,220	10.00	24,140
3.20	1,370	5.00	5,810	6.80	11,560	10.20	25,020
3.30	1,580	5.10	6,100	6.90	11,910	10.40	25,900
3.40	1,790	5.20	6,400	7.00	12,260	10.60	26,780
3.50	2,000	5.30	6,700	7.20	12,970	10.80	27,660
3.60	2,210	5.40	7,000	7.40	13,700	11.00	28,540
3.70	2,430	5.50	7,310	7.60	14,440	11.20	29,420
3.80	2,650	5.60	7,620	7.80	15,200	11.40	30,340
3.90	2,880	5.70	7,930	8.00	15,960	11.60	31,260
4.00	3,120	5.80	8,250	8.20	16,740	11.80	32,180
4.10	3,360	5.90	8,570	8.40	17,520	12.00	33,100
4.20	3,610	6.00	8,890	8.60	18,320	12.20	34,060

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1899–1905. It is well defined between gage heights 2.8 feet and 6.2 feet. The table has been extended beyond these limits, being based on one measurement at 8.2 feet. The table is the same as that for 1904 up to gage height 4 feet.

Estimated monthly discharge of Juniata River at Newport, Pa., for 1905.

[Drainage area, 3,476 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January [a]	15,200	3,120	7,497	2.16	2.49
March (9–31) [b]	34,060	6,400	15,230	4.38	3.75
April	6,400	2,650	3,890	1.12	1.25
May	4,950	2,000	2,646	.761	.877
June	9,870	2,210	3,777	1.09	1.22
July	2,430	1,580	2,139	.615	.709
August	24,140	1,370	4,606	1.33	1.53
September	5,520	320	2,265	.652	.727
October	5,520	950	2,944	.847	.976
November	7,620	1,370	2,204	.634	.707
December (1–30)	14,440	2,650	6,334	1.82	2.03

[a] Ice gorge during a few days in January caused slight backwater. No correction made in estimates.
[b] River frozen February 1 to March 8, approximately; no estimates.

BROAD CREEK AT MILL GREEN, MD.

Broad Creek rises in the northern part of Harford County, Md., flows southeast, then northeast, and unites with Susquehanna River at a point a few miles above the fall line. Its basin, which lies almost wholly in Harford County, is generally hilly and comprises principally farming lands.

The gaging station was established December 14, 1904, by F. H. Tillinghast. It is located in the village of Mill Green, on the steel highway bridge, and is best reached from Cardiff, Md.

The channel is straight for 200 feet above and 500 feet below the station. The bed is rough, and the velocity of the current at the bridge is small at low stages of the stream.

No high-water measurements have been made on this creek; low-water measurements are made by wading at a point about 100 feet above the station.

A standard chain gage is attached to the bridge. The length of the chain from the end of the weight to the marker is 14.97 feet. The gage is read twice daily by James F. Snodgrass. Bench mark No. 1 is a chiseled square on the upstream end of the right abutment; elevation above gage datum, 10.60 feet. Bench mark No. 2 is the top of chord of bridge directly over pulley of gage; elevation above gage datum, 16.31 feet. Bench mark No. 3 is a nail in a large blazed tree about 100 feet upstream from bridge on left bank; elevation above gage datum, 12.83 feet.

Discharge measurements of Broad Creek at Mill Green, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
June 23	Grover and Lyman	14.5	8.8	1.84	2.40	16.2
November 2	G. F. Harley	26.0	26.0	0.46	2.20	11.9
November 2[a]	do	17.0	12.1	1.06	2.25	12.8

[a] Measurement made at different section.

Mean daily gage height, in feet, of Broad Creek at Mill Green, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.45	.....	2.55	2.55	2.5	2.5	2.3	2.3	2.3	2.25	2.2	2.25
2	2.5	.....	2.55	2.52	2.5	2.38	2.5	2.3	2.38	2.25	2.2	2.3
3	2.5	.....	2.7	2.5	2.5	2.3	2.35	2.25	2.82	2.25	2.22	3.5
4	2.5	.....	2.8	2.5	2.45	2.3	2.35	2.25	2.4	2.2	2.25	2.42
5	2.5	.....	2.75	3.0	2.45	2.3	4.4	2.2	2.32	2.15	2.25	2.3
6	4.0	1.9	3.1	2.9	2.45	2.25	3.65	2.2	2.3	2.15	2.28	2.3
7	3.45	.....	2.9	2.65	2.42	3.22	2.48	2.2	2.3	2.2	2.25	2.32
8	2.58	.....	3.08	2.6	2.4	2.65	2.4	2.2	2.3	2.15	2.25	2.32
9	2.5	.....	4.02	2.55	2.4	2.45	2.3	2.3	2.3	2.2	2.25	2.3
10	2.4	.....	3.88	2.55	2.4	2.3	2.3	2.3	2.3	2.15	2.25	2.3
11	2.4	.....	3.28	2.98	2.4	2.3	2.3	2.28	2.38	2.6	2.28	2.25
12	3.0	.....	2.78	2.8	2.4	2.45	2.3	2.25	2.38	2.3	2.22	2.2
13	2.6	.....	2.72	2.65	2.4	2.35	2.3	2.25	2.3	2.2	2.2	2.22
14	2.5	.....	2.7	2.6	2.42	2.32	2.3	2.28	2.3	2.25	2.15	2.25
15	2.8	.....	2.75	2.6	2.45	2.3	2.3	4.35	2.3	2.15	2.18	2.28
16	2.5	.....	2.65	2.6	2.45	2.3	2.3	2.35	2.3	2.15	2.18	2.3
17	2.5	1.5	2.75	2.6	2.45	2.3	2.3	2.25	2.3	2.18	2.14	2.3
18	2.5	.....	2.78	2.6	2.63	2.3	2.3	2.25	2.3	2.1	2.2	2.3
19	2.5	1.5	2.9	2.6	2.42	2.3	2.3	2.22	2.3	2.2	2.25	2.3
20	2.5	.....	3.7	2.6	2.4	2.3	2.28	2.2	2.3	3.45	2.2	2.28
21	2.4	.....	2.88	2.6	2.4	2.3	2.25	2.2	2.28	2.28	2.25	4.0
22	2.4	.....	2.65	2.58	2.4	2.3	2.25	2.2	2.25	2.3	2.25	2.48
23	2.4	.....	2.65	2.55	2.4	2.4	2.52	2.2	2.25	2.18	2.2	2.45
24	2.4	2.4	2.6	2.55	2.35	2.52	2.82	2.2	2.25	2.32	2.2	2.4
25	.....	2.4	2.58	2.55	2.35	2.38	2.32	4.65	2.25	2.28	2.2	2.35
26	.....	2.95	2.55	2.55	2.35	2.3	2.22	2.52	2.25	2.38	2.2	2.3
27	.....	.....	2.55	2.58	2.35	2.3	2.2	2.3	2.25	2.3	2.2	2.32
28	.....	2.5	2.55	2.55	2.35	2.3	2.2	2.3	2.25	2.25	2.2	2.35
29	.....	.....	2.55	2.5	3.32	2.3	2.6	2.3	2.25	2.3	2.78	2.9
30	.....	.....	2.55	2.5	3.2	2.3	2.52	2.3	2.25	2.22	2.35	2.48
31	.....	.....	2.55	.....	2.65	.....	2.32	2.3	.....	2.25	.....	2.32

NOTE.—Creek frozen over January 25 to February 23, inclusive; thickness of ice, 0.8 to 1.4 feet, reaching the bottom in places. Gage was read to surface of water in hole in ice.

DEER CREEK NEAR CHURCHVILLE, MD.

Deer Creek has its headwaters in York County, Pa., flows southeastward through Baltimore and Harford counties, Md., and unites with Susquehanna River opposite Port Deposit. Its basin is hilly and generally in farming lands. Slopes are steep, and at several places small power plants are in use.

The gaging station was established December 14, 1904, by F. H. Tillinghast. It is located at the highway bridge on the Deer Creek road about 3 miles north of Churchville, and is best reached by driving from Belair.

The channel is straight for 500 feet above and below the station. The bed is generally smooth, is composed of sand with a few bowlders, and is practically permanent. The current has a good velocity at all stages.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is on the right bank, at the end of the inclined end post, downstream side of the bridge.

A standard chain gage is attached to the bridge. The length of the chain from the end of the weight to the marker is 15.20 feet. The gage is read twice daily by Harris Archer. The datum of the gage is referred to the following bench marks: No. 1, a chiseled square

on the downstream end of the right abutment, elevation 14.10 feet; No. 2, top of eyebar of bottom chord in middle of second panel from the right bank, elevation 14.68 feet.

Additional discharge measurements are given in Water-Supply Paper No. 126, page 56.

Discharge measurements of Deer Creek near Churchville, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet*	*Feet per second.*	*Feet.*	*Sec.-feet.*
June 23	Grover and Lyman	89	170	1.22	2.05	208
November 2	G. F. Harley	89	150	.80	1.81	119

Mean daily gage height, in feet, of Deer Creek near Churchville, Md., for 1905.

Day.	Jan.	Feb.	Mar	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.85	2.1	2.05	2.1	2.0	1.95	1.65	1.8	1.92	1.7	1.78	1.85
2	1.9	2.1	1.95	2.1	1.9	1.8	2.0	1.75	1.95	1.7	1.75	1.8
3	1.9	2.1	2.05	2.1	1.9	1.8	2.02	1.72	3.5	1.92	1.82	3.5
4	1.65	2.1	2.0	2.2	1.9	1.8	1.75	1.7	2.38	1.8	1.8	2.32
5	1.95	2.1	2.45	2.6	1.9	1.8	1.72	1.65	2.22	1.75	1.8	2.0
6	2.0	2.25	2.2	2.85	1.9	1.75	2.8	.....	2.05	1.72	1.82	1.95
7	5.95	2.2	2.25	2.3	2.1	2.25	2.2	1.68	2.0	1.7	1.78	1.9
8	2.5	2.2	2.2	2.2	2.0	2.0	2.3	1.75	2.0	1.7	1.78	1.9
9	2.2	2.2	3.5	2.1	1.9	1.85	2.0	2.18	2.0	1.7	1.82	1.9
10	2.1	2.2	3.55	2.1	1.9	1.8	1.8	1.82	2.0	1.72	1.8	1.9
11	2.0	2.2	2.8	3.05	1.9	1.8	1.82	1.8	2.05	1.85	1.8	1.85
12	2.45	2.2	2.55	2.45	1.9	2.45	1.78	1.75	2.35	2.38	1.75	1.85
13	2.35	2.9	2.4	2.75	1.85	2.0	1.92	2.55	2.02	1.92	1.78	1.85
14	2.0	2.55	2.35	2.2	1.9	1.85	1.85	1.92	1.92	1.8	1.78	1.8
15	2.1	2.3	2.25	2.1	2.05	1.8	1.8	1.9	1.9	1.75	1.75	1.82
16	2.3	2.3	2.25	2.1	2.05	1.8	1.75	2.08	1.9	1.75	1.78	1.75
17	2.1	2.3	2.3	2.0	1.9	1.75	1.7	1.82	2.2	1.75	1.78	1.85
18	2.1	2.3	2.25	2.15	2.2	1.7	1.7	1.75	2.08	1.75	1.75	1.95
19	2.0	2.3	2.35	2.2	1.85	1.7	1.7	1.7	1.95	1.78	1.75	1.88
20	2.0	2.3	2.95	2.1	1.8	1.7	1.65	1.7	1.9	3.35	1.78	1.85
21	1.9	2.3	3.4	2.1	1.8	1.7	1.65	1.7	1.85	2.1	1.78	5.05
22	1.8	2.4	2.8	2.1	1.8	2.0	1.65	2.05	1.85	2.0	1.75	2.4
23	1.75	2.3	2.45	2.0	1.8	2.0	2.0	1.75	1.8	1.92	1.75	2.18
24	1.7	2.3	2.3	2.0	1.8	2.15	2.42	1.72	1.8	1.82	1.75	2.05
25	1.5	2.3	3.5	2.0	1.7	1.9	1.82	5.48	1.82	2.1	1.78	1.98
26	1.6	3.15	2.55	2.0	1.7	1.8	1.7	2.98	1.8	2.3	1.7	1.92
27	2.3	2.9	2.45	2.15	1.75	1.7	1.7	2.35	1.8	2.08	1.7	1.95
28	2.25	2.25	2.3	2.1	1.8	1.7	1.7	2.18	1.75	1.95	1.72	1.9
29	2.1	.....	2.2	2.05	1.75	1.65	2.05	2.1	1.75	1.85	2.42	2.62
30	2.15	.....	2.2	2.0	1.8	1.65	2.35	2.05	1.7	1.88	2.15	2.15
31	2.1	.....	2.2	.....	2.35	.....	2.05	2.0	.....	1.85	.....	2.0

NOTE.—From January 26 to February 22 creek was frozen entirely across from the dam to a point 200 feet below the gage; thickness of ice, 0.9 foot. During this period occasional readings to the water surface in a hole in the ice were taken and coincided very nearly with the readings to the top of the ice. From February 22 to March 4 the ice was melting and going out.

MISCELLANEOUS MEASUREMENTS.

The following is a list of miscellaneous discharge measurements made in the Susquehanna River drainage basin during 1905:

Miscellaneous discharge measurements in Susquehanna River drainage basin.

Date.	Stream.	Locality.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1905.				*Feet.*	*Sq ft.*	*Feet per second.*	*Feet.*	*Sec.-ft.*
Aug. 22	Cayuta Creek...	Waverly, N. Y..	Covert and Wees.	.....	96	0.49	(a)	47
Oct. 3	Unadilla River.	S. Edmeston, N. Y.	C. C. Covert...	69	376	1.61	(b)	607
Oct. 4	Chenango River	S. Oxford, N. Y.	.....do.....	113	565	1.39	(c)	786
Oct. 4	Susquehanna River.	Highway bridge, Sydney, N. Y.	.....do.....	194	1,091	1.59	(d)	1,738

a 17.16 feet: distance to water surface from top of hand-rail, station 20, upstream side.
b Water surface 7.8 feet below downstream corner, left-hand abutment.
c Water surface 12.8 feet below top of guard rail, upstream side of bridge.
d Water surface 25.4 feet below top of hand rail, 25 feet from left-hand end of bridge, upstream side.

GUNPOWDER RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The headwaters of Gunpowder River lie in York County, Pa., near the Maryland line. Thence the river flows southeastward through Baltimore County, Md., and empties into Chesapeake Bay about 10 miles northeast of Baltimore. The river, though small, has steep slopes, and the powers have considerable value on account of their proximity to a large city. A portion of the water supply for Baltimore is taken from this river at Loch Raven, and the city has purchased all the power rights below this place. Little Gunpowder Falls, which is tributary below the fall line, has the same general characteristics as the larger river. Throughout its entire length it forms the boundary between Harford and Baltimore counties, Md. There are several small power developments.

GUNPOWDER FALLS AT GLENCOE, MD.

This station was established December 15, 1904, by F. H. Tillinghast. It is located at a steel highway bridge near the Pennsylvania Railroad station at Glencoe.

The channel is straight for 300 feet above and 300 feet below the station. The bed is smooth and of sand and shifts slightly. The velocity of the current is good at all stages.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the end of the end post on the left bank.

A standard chain gage is attached to the upstream truss of the bridge. In the spring of 1905 the bridge was lowered, and the chain was shortened so that the gage continued to read to the same datum. The length of chain is 22.05 feet. The gage is read twice daily by Samuel Wilhelm, the station agent at Glencoe. Bench mark No. 1 is a chiseled cross on the downstream corner of the left abutment; elevation, 18.30 feet. Bench mark No. 2 is the top of iron standard of gate at railroad crossing nearest bridge; elevation, 19.77 feet.

Discharge measurements of Gunpowder Falls at Glencoe, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
June 22	Grover and Lyman	66	93	1.48	1.53	138
November 3	F. F. Henshaw	66	89	1.55	1.80	138

Mean daily gage height, in feet, of Gunpowder Falls at Glencoe, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.02	2.3	2.6	2.12	1.82	1.82	1.38	2.0	2.12	1.7	1.92	1.88
2	2.05	2.28	2.38	2.08	1.78	1.68	1.68	1.82	4.0	1.65	1.82	1.85
3	2.18	2.15	2.2	2.02	1.78	1.62	1.52	1.78	3.72	1.75	1.88	3.88
4	1.9	2.15	2.75	1.92	1.78	1.58	1.42	1.72	2.78	1.75	1.88	2.75
5	2.22	2.08	2.62	2.72	1.72	1.68	1.45	1.68	2.42	1.72	1.88	2.28
6	2.25	2.25	2.45	3.15	1.78	1.6	3.35	1.6	2.15	1.72	1.88	2.12
7	8.1	2.32	2.68	2.38	1.75	3.18	2.65	1.68	2.1	1.62	1.88	2.08
8	3.08	2.2	2.4	2.2	1.75	2.28	2.52	1.75	2.22	1.62	1.85	2.02
9	2.4	2.32	4.38	2.18	1.78	1.82	2.25	2.05	2.05	1.58	1.82	2.0
10	2.2	2.32	4.4	2.0	1.68	1.68	2.05	1.88	1.98	1.52	1.8	2.02
11	2.1	2.2	3.22	3.7	1.68	1.62	1.8	1.8	2.35	3.52	1.78	1.98
12	2.65	2.28	3.05	2.82	1.68	2.02	1.8	1.68	2.48	2.6	1.75	1.92
13	2.5	3.12	2.7	2.62	1.68	2.0	2.75	2.82	2.18	2.08	1.8	1.95
14	2.02	2.55	2.58	2.35	1.92	1.7	2.15	2.42	2.02	1.92	1.75	1.9
15	3.1	2.5	2.42	2.3	1.98	1.65	2.0	2.12	2.0	1.88	1.72	1.9
16	3.2	2.3	2.38	2.3	1.98	1.62	1.78	2.52	1.98	1.82	1.78	2.22
17	3.2	2.45	2.48	2.2	1.8	1.58	1.78	2.02	1.95	1.8	1.75	1.95
18	2.95	2.35	2.5	2.18	2.05	1.48	1.7	1.85	1.92	1.82	1.8	2.75
19	2.65	2.4	2.45	2.05	1.78	1.48	1.62	1.78	2.02	1.82	1.7	2.5
20	2.55	2.35	3.32	2.02	1.7	1.52	1.62	1.82	1.98	4.92	1.7	1.9
21	2.45	2.6	4.3	2.05	1.62	1.55	1.58	1.8	1.9	2.5	1.7	6.55
22	1.6	2.6	3.08	2.08	1.65	1.4	1.6	1.72	1.88	2.15	1.65	3.05
23	1.78	2.4	2.7	1.92	1.6	1.82	2.02	1.72	1.82	2.08	1.7	2.75
24	1.7	2.42	2.48	1.92	1.55	2.9	2.22	1.72	1.82	2.05	1.7	2.45
25	1.62	2.5	4.38	1.88	1.55	2.0	1.9	8.7	1.82	1.95	1.75	2.25
26	2.5	3.15	3.02	1.9	1.55	1.78	1.72	3.88	1.85	2.52	1.65	2.2
27	2.8	3.85	1.78	1.98	1.55	1.72	1.7	2.88	1.78	2.1	1.7	2.1
28	2.48	2.78	2.52	2.0	1.5	1.6	1.82	2.52	1.68	2.0	1.7	2.1
29	2.2	.....	2.4	1.98	1.4	1.48	2.72	2.28	1.62	1.95	3.18	3.0
30	2.35	.....	2.3	1.98	1.55	1.52	2.55	2.22	1.68	2.0	2.3	2.5
31	2.3	.....	2.22	.....	2.0	.....	2.28	2.12	.....	1.98	.....	2.1

NOTE.—River frozen January 4–6; also January 15 to March 4, inclusive. During this period the gage was read to the top of the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 6	2.1	2.25	0.6
February 8	2.15	2.2	.6
February 11	2.15	2.2	.7
February 14	2.5	2.55	.7
February 16	2.25	2.3	.8
February 18	2.3	2.35	.8
February 23	2.35	2.4	.8
February 25	2.45	2.5	.8

LITTLE GUNPOWDER FALLS NEAR BELAIR, MD.

This station was established December 13, 1904, by F. H. Tillinghast. It is located at a steel highway bridge on the road from Belair to Kingsville, at a distance of about 5 miles from Belair, from which place it is best reached by driving.

The channel is straight for 300 feet above and 100 feet below the station. The bed is sand, with bowlders, and may shift slightly in the sand. The velocity of the current is good at all stages. There is a flood plain 100 feet wide on the right bank.

Discharge measurements are made from the upstream side of the bridge, to which the gage is attached. The initial point for soundings is the face of abutment on the right bank.

A standard chain gage is attached to the bridge. The length of the chain from the end of the weight to the marker is 13.36 feet. The gage is read twice daily by A. D. Unkhart. Bench mark No. 1 is a chiseled square on the downstream end of right abutment; elevation, 13.36 feet. Bench mark No. 2 is top of pulley wheel; elevation, 12.96 feet.

Additional discharge measurements are given in Water-Supply Paper No. 126, page 58.

Discharge measurements of Little Gunpowder Falls near Belair, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
June 22	Grover and Lyman	33	32	1.56	1.50	49.9
November 1	G. F. Harley	38	47	.95	1.39	44.5

Mean daily gage height, in feet, of Little Gunpowder Falls near Belair, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.72	2.1	1.8	1.72	1.68	1.75	1.42	1.55	1.42	1.35	1.75	1.5
2	1.75	2.28	1.85	1.72	1.6	1.45	1.72	1.52	1.7	1.42	1.75	1.42
3	1.72	2.08	1.95	1.7	1.62	1.35	1.48	1.48	2.35	1.42	1.75	2.5
4	1.58	2.15	2.1	1.7	1.6	1.5	1.48	1.45	1.68	1.42	1.52	1.65
5	1.92	2.05	2.02	2.3	1.68	1.58	1.38	1.45	1.5	1.38	1.42	1.65
6	1.78	2.22	2.02	2.5	1.68	1.58	3.48	1.42	1.5	1.42	1.42	1.55
7	3.62	2.2	1.88	1.9	1.68	1.82	2.02	1.45	1.52	1.38	1.48	1.52
8	2.0	2.1	2.25	1.75	1.6	1.78	1.72	1.48	1.38	1.35	1.5	1.58
9	1.85	2.2	3.38	1.78	1.6	1.55	1.6	1.45	1.58	1.3	1.55	1.32
10	1.72	2.12	2.85	1.72	1.62	1.52	1.58	1.38	1.48	1.38	1.48	1.55
11	1.7	1.9	2.2	2.32	1.6	1.52	1.55	1.42	1.55	2.08	1.6	1.45
12	2.32	2.08	2.1	2.02	1.6	2.38	1.8	1.38	1.48	1.72	1.42	1.48
13	1.82	2.8	2.38	1.88	1.72	1.8	1.78	1.5	1.48	1.42	1.38	1.4
14	1.75	2.32	1.92	1.82	1.85	1.58	1.72	1.45	1.52	1.42	1.3	1.42
15	1.92	2.1	1.82	1.85	1.9	1.48	1.6	1.52	1.42	1.38	1.32	1.3
16	2.12	1.95	1.8	1.8	1.78	1.52	1.5	1.52	1.4	1.42	1.32	1.6
17	2.12	1.9	1.85	1.72	1.7	1.52	1.45	1.45	1.4	1.38	1.45	1.48
18	1.8	2.0	1.88	1.68	1.9	1.52	1.48	1.28	1.45	1.38	1.3	1.62
19	1.7	1.95	1.88	1.7	1.7	1.68	1.42	1.4	1.48	1.38	1.38	1.58
20	1.62	1.85	2.45	1.7	1.65	1.55	1.48	1.4	1.45	1.85	1.42	1.48
21	1.68	1.8	2.68	1.75	1.55	1.52	1.38	1.4	1.45	1.42	1.3	4.1
22	1.6	1.92	2.08	1.75	1.6	1.48	1.38	1.4	1.48	1.45	1.28	1.82
23	1.55	1.75	1.88	1.68	1.55	1.78	1.58	1.32	1.42	1.38	1.22	1.72
24	1.5	1.82	1.88	1.7	1.52	1.8	2.12	1.38	1.42	1.38	1.4	1.62
25	1.5	2.0	3.02	1.72	1.48	1.65	1.42	2.2	1.4	1.5	1.4	1.6
26	2.18	2.4	1.95	1.68	1.65	1.5	1.48	1.78	1.45	1.48	1.35	1.58
27	2.1	2.28	1.82	1.72	1.6	1.52	1.45	1.42	1.4	1.98	1.38	1.55
28	1.9	1.82	1.78	1.68	1.52	1.45	1.42	1.48	1.4	1.58	1.42	1.52
29	1.78	.....	1.85	1.72	1.5	1.42	2.8	1.45	1.4	1.48	2.2	2.28
30	1.65	.....	1.8	1.7	1.5	1.45	3.0	1.45	1.4	1.52	1.65	1.65
31	1.9	.....	1.82	.....	1.88	.....	1.68	1.4	.....	1.82	.....	1.6

NOTE.—River frozen January 1-6 and January 26 to February 25. For this period the readings were to the top of ice. The ice was approximately 0.9 foot thick. The following comparative readings were made:

Date.	Water surface.	Top of ice.
	Feet.	*Feet.*
February 7	2.0	2.2
February 11	1.6	1.9
February 15	1.9	2.1
February 17	1.95	1.9
February 21	1.6	1.8
February 23	1.6	1.75
February 25	2.0	2.0

PATAPSCO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Patapsco River is formed by the junction of North Branch and South or Piney Branch near Marriottsville, Md., and flows in a southeasterly direction into Chesapeake Bay 13 miles south of Baltimore. Both branches rise in the central part of Maryland, and the whole basin, which has an area of about 350 square miles, lies within that State.

The drainage basin is hilly and largely under cultivation. It has no lakes or artificial reservoirs, and the flow of the stream is variable. The maximum estimated flow at the gaging station at Woodstock, Md., where the drainage area is 251 square miles, is about 12,000 second-feet, while the minimum estimated flow has been about 50 second-feet. The record from which these estimates have been taken extends over a period of nine and one-half years. The freshets do not, however, cause very large rises of the water because of the steep slope of the stream. The maximum recorded difference in gage height at Woodstock is 13 feet, while the usual range within a year is about 3 or 4 feet.

The bed is generally rock. The banks are of rock and very little land is subject to overflow. The Baltimore and Ohio Railroad follows the stream closely throughout nearly its entire length.

The river carries a small volume of water, but as it has considerable slope a large number of water powers have been developed along its course. These, though small, are made valuable by their proximity to Baltimore.

PATAPSCO RIVER AT WOODSTOCK, MD.

This station was established August 6, 1896, by E. G. Paul. It is located near the railroad station at Woodstock, 1.5 miles below the mouth of the North Branch.

The channel is straight for 150 feet above and several hundred feet below the station. At ordinary stages the river flows in one channel 100 feet wide; at high stages it flows in two channels 220 feet wide. The velocity is rapid. Both banks are high and are not subject to overflow. The right bank is without trees; the left is wooded. The bed of the stream is rough and is composed of bowlders and cobblestones. It is subject to change at extreme high water.

Discharge measurements are made from the upper side of the iron highway bridge to which the gage is attached. The initial point for soundings is near the right bank.

The original wire gage was destroyed when the bridge was repaired January 20-25, 1899, and a new wire gage was established January 30, 1899, on the same datum. On November 11, 1903, a standard chain gage was installed on the upper side of the bridge. The datum was not changed. The length of the chain from the end of the weight to the marker is 28.28 feet. The gage is read twice daily by William Donovan. The bench mark is a United States Geological Survey standard copper bolt set in the face of the retaining wall at the entrance to the college grounds at the north end of the bridge. Its elevation is 22.06 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 16; 22, iv, p 130; WS 15, p 13; 27, p 10; 35, p 83; 48, p 115; 65, p 228; 75, p 33; 82, p 165; 97, p 303; 126, pp 58-59.

Discharge: Ann 18, iv, p 17; WS 15, p 13; 27, p 23; 35, p 83; 48. p 115; 65, p 228; 82, p 165; 97, p 303; 126 p 59.

Discharge, monthly: Ann 18, iv, p 17; 19, iv, p 130; 20, iv, pp 113, 115; 21, iv, p 94; 22, iv, p 130; WS 75, p 33; 82, p 167; 97, p 305.

Discharge, yearly: Ann 20, iv, p 48.

Gage heights: WS 11, p 8; 15, p 13; 27, p 18; 35, p 83; 48, p 115; 65, p 228; 82, p 166; 97, p 304; 126, pp 59-60.

Hydrographs: Ann 19, iv, p 130; 20, iv, p 115; 22, iv, p 131.

Rating tables: Ann 18, iv, p 17; 19, iv, p 129; WS 27, p 24; 39, p 442; 52, p 511; 65, p 318; 82, p 166; 97, p 304.

Discharge measurements of Patapsco River at Woodstock, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 12	Tillinghast and Comstock	105	200	3.87	4.90	774
June 21	Grover and Lyman	101	87	2.13	3.86	186
October 31	G. F. Harley	102	119	2.22	4.07	264

Mean daily gage height, in feet, of Patapsco River at Woodstock, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.05	3.9	4.1	4.2	4.05	3.9	3.75	4.1	3.9	3.7	3.75	4.0
2	4.0	3.95	4.0	4.2	3.95	3.8	4.55	3.95	3.95	3.7	3.75	3.85
3	4.15	4.1	3.95	4.25	3.95	3.75	3.95	3.85	4.8	3.95	3.75	6.5
4	4.2	4.0	4.35	4.15	3.95	3.75	3.75	3.8	4.1	3.85	3.7	4.4
5	4.55	3.85	4.65	4.8	3.95	3.95	3.9	.....	3.95	3.8	3.6	4.0
6	4.25	4.05	4.85	5.2	3.9	3.7	5.53	3.8	3.85	3.7	3.65	4.0
7	8.05	3.95	4.7	4.45	4.05	4.75	4.4	3.8	3.95	3.75	3.75	3.9
8	4.55	4.2	4.5	4.25	3.9	4.05	3.95	3.9	3.9	3.8	3.75	3.9
9	4.25	3.9	6.25	4.3	3.9	3.8	4.3	4.8	3.8	3.7	3.8	4.0
10	4.1	4.1	6.5	4.25	3.8	3.85	3.95	4.0	3.75	3.7	3.75	4.0
11	3.95	4.15	5.15	4.7	3.9	3.75	3.85	3.9	4.4	4.2	3.8	4.0
12	4.45	4.2	4.8	4.5	3.85	5.4	3.8	3.85	4.0	4.35	3.65	3.9
13	4.3	4.25	4.6	4.5	3.8	4.4	5.47	4.1	3.85	3.95	3.8	3.95
14	4.05	4.4	4.45	4.25	4.0	4.0	4.97	4.05	4.0	3.65	3.75	4.0
15	4.3	4.1	4.35	4.5	4.6	3.9	4.75	4.1	3.9	3.85	3.7	3.9
16	4.35	4.1	4.3	4.25	4.35	3.8	4.15	4.4	3.9	3.9	3.75	3.95
17	4.0	4.0	4.3	4.2	4.0	3.8	3.95	4.15	3.85	3.65	3.7	3.9
18	4.0	4.05	4.35	4.05	4.4	3.65	3.9	3.95	4.2	3.75	3.7	3.8
19	3.95	4.25	4.45	4.1	4.1	3.8	3.8	3.85	4.0	3.7	3.8	3.95
20	3.9	4.2	5.5	4.05	3.9	3.75	3.8	3.9	3.95	4.4	3.8	3.95
21	3.85	4.0	5.75	4.05	3.95	3.7	3.8	3.8	3.9	3.95	3.75	9.45
22	3.95	4.2	5.3	4.15	3.9	3.65	3.7	3.8	3.85	3.8	3.8	4.8
23	3.85	4.2	4.75	4.15	3.85	4.55	6.43	3.75	3.8	3.75	3.85	4.45
24	3.8	4.05	4.6	4.15	3.75	5.25	4.25	3.7	3.65	3.65	3.8	4.35
25	3.8	4.15	6.05	4.05	3.8	4.3	4.05	10.07	3.9	4.1	3.75	4.25
26	3.95	4.2	4.9	4.0	3.8	4.05	3.95	5.35	3.9	4.4	3.9	4.2
27	4.0	5.35	4.7	4.45	3.8	4.0	4.0	4.5	3.8	4.05	3.8	4.15
28	4.2	4.5	4.5	4.2	3.75	3.75	3.85	4.15	3.8	3.9	3.85	4.1
29	4.25	.....	4.45	4.15	3.75	3.75	5.05	4.05	3.7	3.75	4.55	4.65
30	4.25	.....	4.45	4.1	3.85	3.7	5.25	4.05	3.7	3.85	4.15	4.35
31	4.0	.....	4.25	.....	3.95	.....	4.55	3.95	.....	3.75	.....	4.15

NOTE.—During February the river was frozen entirely across above the gage. From the gage a narrow channel of open water extended downstream. The gage readings are to the water surface. Thickness of ice, 0.5 to 1 foot.

Station rating table for Patapsco River at Woodstock, Md., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	36	3.70	139	4.20	332	4.70	629
3.30	50	3.80	170	4.30	383	4.80	701
3.40	66	3.90	204	4.40	438	4.90	777
3.50	86	4.00	242	4.50	497	5.00	857
3.60	111	4.10	285	4.60	561		

NOTE.—The above table is applicable only for open channel conditions. It is based on six discharge measurements made during 1904 and 1905. It is well defined between gage heights 3.25 feet and 5 feet. Above 5 feet discharge was estimated.

Estimated monthly discharge of Patapsco River at Woodstock, Md., for 1904 and 1905.

[Drainage area, 251 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
January 22-31	2,877	223	775	3.09	1.15
February	7,173	139	498	1.98	2.14
March	1,444	187	345	1.37	1.58
April	308	125	194	.773	.862
May	332	76	145	.578	.666
June	285	50	120	.478	.534
July	1,348	66	207	.825	.951
August	308	58	117	.466	.537
September	898	50	110	.438	.489
October	1,160	58	137	.546	.630
November	285	66	136	.542	.604
December	1,160	58	245	.976	1.13
1905.					
January	3,822	170	412	1.64	1.89
March	2,283	223	739	2.94	3.39
April	1,026	242	390	1.55	1.73
May	561	154	230	.917	1.06
June	1,206	125	285	1.14	1.27
July	2,214	139	463	1.84	2.12
August	5,891	139	463	1.84	2.12
September	701	125	226	.900	1.00
October	438	125	203	.809	.933
November	529	111	174	.693	.773
December	5,252	170	520	2.07	2.39

NOTE.—Ice conditions during January, 1904, and February, 1905; no estimate made.

POTOMAC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Potomac River is formed by the junction of the North and South branches, about 15 miles below Cumberland, Md., from which point it flows in a southeasterly direction into Chesapeake Bay. For its entire length it makes the southern boundary of the State of Maryland and the northern boundary of the States of West Virginia and Virginia. It drains a total area of about 14,500 square miles.

North Branch rises in the Allegheny Mountains near the west corner of Maryland, South Branch in the Alleghenies in Virginia and West Virginia These branches, with their tributaries and the tributaries of the main stream as far down as the Shenandoah, drain a series of narrow and generally fertile valleys lying between the parallel ranges which make up the system of the Alleghenies in this region. Their slopes are not, as a rule, very great, and their beds are of gravel and sand. The slopes of their drainage basins are, however, usually very steep, and after a rain the water collects quickly in the rivers. There are few lowlands to be overflowed, and no lakes whatever in the region. Consequently these streams, and with them Potomac River, are subject to very sudden and heavy freshets in wet seasons, while in dry seasons their discharge becomes small. The record of gage height at Point of Rocks, Md., covering a period of nearly eleven years, shows a maximum range of 29 feet, and for several years the range has been more than 20 feet each year. The corresponding maximum and minimum discharges have been estimated at 218,700 and 900 second-feet, respectively.

The slopes of the tributary basin of Shenandoah River are in many instances steep, but the valley through which the Shenandoah flows is generally broader and more lands are subject to overflow. The slope of the river itself is usually greater than the slope of the tributaries above mentioned. As a result the fluctuations of this stream are not so great, having a maximum range of about 19 feet at Millville in eleven years, while the average annual fluctuation is 10 feet or less. The discharge in this period has ranged between 140,000 and 480 second-feet.

From the junction of North and South branches below Cumberland, Md., the Potomac cuts through the mountains at nearly a right angle. Its valley is narrow, its slope in many places great. The bed is generally gravel and bowlders, with ledge rock at small depth, which often appears at the surface. The banks are usually high and are not subject to overflow. It crosses the fall line a few miles above Washington and reaches tide water at Georgetown.

The Baltimore and Ohio Railroad follows the river for its entire length, and the Shenandoah Valley and the Cumberland Valley railroads cross the stream. The Chesapeake and Ohio Canal follows it from Cumberland to Georgetown.

As a water-power stream the principal disadvantage of the Potomac is the great variability of its flow. Good rock foundations for dams can generally be found at small depth, the banks are, as a rule, favorable, and there are several sites where large falls could be rendered available. A very insignificant amount of power has been developed.

During 1905 the United States Geological Survey has maintained gaging stations in this basin at the following points:

North Branch Potomac River, at Piedmont, W. Va.
Potomac River, at Point of Rocks, Md.
South Branch Potomac River, near Springfield, W. Va.
Savage River, at Bloomington, Md.
Georges Creek, at Westernport, Md.
Wills Creek, at Cumberland, Md.
Opequon Creek, near Martinsburg, W. Va.
Tuscarora Creek, at Martinsburg, W. Va.
Antietam Creek, near Sharpsburg, Md.
Shenandoah River, at Millville, W. Va.
South Branch Shenandoah River, near Front Royal, Va.
South River, at Basic, Va.
Lewis Creek, near Staunton, Va.
Cooks Creek, at Mount Crawford, Va.
Elk Run, at Elkton, Va.
Hawksbill Creek, near Luray, Va.
North Branch Shenandoah River, near Riverton, Va.
Passage Creek, at Buckton, Va.
Monocacy River, near Frederick, Md.

NORTH BRANCH POTOMAC RIVER AT PIEDMONT, W. VA.

This station was established June 27, 1899, by E. G. Paul. It is located at the iron highway bridge connecting Luke, Md., with Piedmont, W. Va.

The channel is straight for 1,200 feet above and 600 feet below the station. The current has a moderate velocity. The right bank is high and rocky and will not overflow. The left bank is low and liable to overflow, but all water passes beneath the bridge. The bed of the stream is composed of gravel and cobblestones, is free from vegetation, and is permanent.

Discharge measurements are made from the bridge to which the gage is attached from the downstream side. The initial point for soundings is the face of the pier on the right bank.

The standard chain gage is attached to the hand rail on the lower side of the bridge in the span next to the right bank. The length of the chain from the end of the weight to the marker is 38.87 feet. The gage is read twice each day by Charles H. Beck. The bench mark is the top of a small shoulder in the face of the sandstone ledge which forms the right abutment of the bridge. It is about 4 feet above the ground and 10 feet downstream from the bridge. The point is indicated by an arrow cut in the vertical face of the ledge. Its elevation is 20.40 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann= Annual Report; WS= Water-Supply Paper):

Description: WS 35, p 84; 48, p 115; 65, p 229; 82, pp 167-168; 97, p 322; 126, pp 61-62.
Discharge: WS 35, p 84; 48, p 115; 65, p 229; 82, pp 168-169; 97, p 322; 126, p 62.
Discharge, monthly: Ann 22, iv, p 132; WS 75, p 34; 82, p 169; 97, p 324.
Gage heights: WS 35, p 84; 48, p 116; 65, p 229; 82, p 168; 97, p 323; 126, p 62.
Hydrograph: Ann 22, iv, p 133.
Rating tables: Ann 19, iv, p 146; WS 48, p 115; 52, p 511; 65, p 318; 82, p 169; 97, p 323.
Rainfall and run-off relation: Ann 20, iv, p 121.

Discharge measurements of North Branch Potomac River at Piedmont, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 9	E. C. Murphy	286	1,076	4.20	6.70	4,516
March 10	do	286	1,305	4.63	7.47	6,047
March 29	do	153	339	3.23	4.25	1,096
April 18	N. C. Grover	144	235	1.77	3.46	416
April 24	A. H. Horton	146	277	1.90	3.63	526
May 4	Tillinghast and Soper	143	227	1.43	3.22	326
June 7	R. H. Bolster	144	263	1.67	3.44	441
July 17	N. C. Grover	142	195	1.44	3.15	280
November 7	Hanna and Grieve	145	258	1.70	3.38	439

Mean daily gage height, in feet, of North Branch Potomac River at Piedmont, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.05	2.75	3.35	3.85	3.5	4.75	3.3	3.85	2.8	2.3	3.2	3.9
2	3.05	2.7	3.25	3.7	3.3	4.0	3.85	3.45	2.8	2.3	3.1	3.75
3	3.05	2.65	3.15	3.6	3.3	3.65	3.55	3.2	2.8	2.4	3.05	5.75
4	2.95	2.55	3.15	3.55	3.2	3.4	3.4	3.1	2.8	2.45	3.0	4.9
5	2.95	2.55	3.35	3.55	3.2	3.3	4.05	3.5	2.7	2.4	3.0	4.4
6	2.95	2.55	4.15	3.8	3.2	3.2	4.2	3.15	2.6	2.35	3.15	3.95
7	2.9	2.55	4.5	3.95	3.3	3.55	4.3	3.0	2.5	2.3	3.36	3.85
8	2.8	2.55	5.0	3.95	3.2	4.15	5.45	2.85	2.5	2.2	3.2	3.7
9	2.75	2.55	7.05	3.95	3.1	3.65	4.55	2.8	2.5	2.2	3.2	3.65
10	2.65	3.15	7.45	4.0	3.1	3.45	4.05	2.8	2.45	2.2	3.05	3.6
11	2.75	3.1	6.3	3.95	3.15	3.85	4.1	3.2	4.2	2.65	3.0	3.3
12	2.8	3.05	5.7	3.95	3.5	4.2	4.0	3.25	4.15	3.6	2.9	3.25
13	5.95	3.05	5.65	3.85	3.9	4.15	3.95	3.0	3.6	3.05	2.9	3.35
14	4.45	3.4	5.3	3.75	3.65	3.75	3.5	2.8	3.25	2.75	2.9	3.25
15	3.65	3.3	5.0	3.65	5.02	3.45	3.35	2.85	3.05	2.6	2.9	3.0
16	3.3	3.05	4.85	3.55	4.4	3.25	3.3	4.15	2.9	2.55	2.85	2.95
17	3.25	2.95	6.1	3.5	4.55	3.05	3.15	3.5	2.8	2.5	3.05	3.3
18	3.25	2.95	6.45	3.5	4.05	3.65	3.05	3.15	2.8	2.45	3.0	3.2
19	3.25	2.85	6.75	3.45	3.95	3.45	2.95	3.0	2.8	3.8	2.9	3.1
20	3.25	2.85	6.7	3.75	3.75	3.65	3.35	2.95	2.7	4.45	2.9	3.1
21	3.25	2.85	8.1	3.85	3.55	3.65	3.30	2.9	2.6	4.0	2.9	4.0
22	3.3	2.95	6.75	3.9	3.5	3.65	3.10	2.75	2.55	3.4	2.75	5.4
23	3.15	3.4	5.8	3.85	3.4	3.4	3.65	2.65	2.5	3.15	2.75	4.9
24	3.05	3.3	5.25	3.7	3.2	3.45	3.6	2.5	2.4	3.0	2.85	4.9
25	2.85	3.25	5.65	3.6	3.1	3.65	3.25	4.35	2.45	2.95	2.8	4.05
26	2.55	3.25	5.05	3.5	3.1	3.45	3.05	4.9	2.4	4.85	2.8	4.0
27	2.55	3.55	4.9	2.8	3.1	4.4	2.9	3.7	2.4	4.4	2.8	3.85
28	2.75	3.45	4.6	2.9	3.0	3.65	2.8	3.35	2.3	3.9	2.8	3.65
29	2.75	.....	4.3	2.65	2.9	3.35	2.9	3.15	2.3	3.6	3.65	3.8
30	2.85	.....	4.15	3.5	2.9	3.2	5.05	3.0	2.3	3.45	4.55	4.15
31	2.75	.....	4.0	.....	3.15	.....	4.2	3.0	.....	3.3	.....	3.65

NOTE.—Ice went out March 7.

Station rating table for North Branch Potomac River at Piedmont, W. Va., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	15	3.60	515	5.10	2,010	6.60	4,340
2.10	24	3.70	584	5.20	2,130	6.70	4,530
2.20	36	3.80	660	5.30	2,260	6.80	4,720
2.30	51	3.90	742	5.40	2,390	6.90	4,910
2.40	68	4.00	830	5.50	2,530	7.00	5,100
2.50	88	4.10	923	5.60	2,670	7.10	5,300
2.60	110	4.20	1,020	5.70	2,820	7.20	5,500
2.70	134	4.30	1,120	5.80	2,970	7.30	5,700
2.80	161	4.40	1,225	5.90	3,130	7.40	5,910
2.90	191	4.50	1,330	6.00	3,290	7.50	6,120
3.00	224	4.60	1,440	6.10	3,460	7.60	6,330
3.10	261	4.70	1,550	6.20	3,630	7.70	6,540
3.20	302	4.80	1,660	6.30	3,800	7.80	6,760
3.30	347	4.90	1,775	6.40	3,980	7.90	6,980
3.40	397	5.00	1,890	6.50	4,160	8.00	7,200
3.50	453						

NOTE. The above table is applicable only for open channel conditions. It is based on eight discharge measurements made during 1905 and two during 1904. It is fairly well defined between gage heights 3 feet and 7.5 feet. The table has been extended beyond these limits. Below 3 feet the table is based on two measurements at 2 feet. The application of this table for 1904 introduces a possible error of 10 to 20 per cent in estimates.

Estimated monthly discharge of North Branch Potomac River at Piedmont, W. Va., for 1904–5.

[Drainage area, 406 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
[a] 1904.					
January	4,720	110	643	1.58	1.82
February	3,630	224	795	1.96	2.11
March	4,340	484	1,433	3.53	4.07
April	2,195	372	937	2.31	2.58
May	3,210	302	792	1.95	2.25
June	786	134	392	.966	1.08
July	425	60	160	.394	.454
August	99	9	37	.091	.105
September	30	6	17	.042	.047
October	68	12	28	.069	.080
November	51	15	34	.084	.094
December	1,660	15	243	.599	.691
The year	4,720	6	459	1.13	15.38
1905.					
January	3,210	99	360	.887	1.02
February	484	99	232	.571	.595
March	7,420	282	2,484	6.12	7.06
April	830	161	585	1.44	1.61
May	1,914	191	496	1.22	1.41
June	1,605	242	589	1.45	1.62
July	2,460	161	653	1.61	1.86
August	1,775	88	376	.926	1.07
September	1,020	51	195	.480	.536
October	1,718	36	348	.857	.988
November	1,385	148	267	.658	.734
December	2,895	208	815	2.01	2.32
The year	7,420	36	617	1.52	20.82

[a] 1904 estimates may be too low by 10 to 20 per cent.

NOTE.—Ice conditions unknown; discharge applied as for open channel.

POTOMAC RIVER AT POINT OF ROCKS, MD.

This station was established by C. C. Babb February 17, 1895. It is located at the steel highway bridge at Point of Rocks, Md.

The channel is straight for 500 feet above and 200 feet below the station. It is 1,300 feet wide, broken by seven bridge piers. Both banks overflow only at extremely high water, and are not wooded. In the two right spans the bed is composed of mud, and is subject to some change; in the other spans the bed is composed of gravel and cobblestones and is permanent. The current does not flow at right angles with the bridge in all of the spans.

Discharge measurements are made from the eight-span steel toll bridge, to which the gage is attached. The initial point for soundings is the left end of the lower guard rail, 0.4 foot beyond the center of the end pin, on the downstream side of the bridge.

As originally placed the gage was located in the third span of the bridge from the left bank. The length of the wire from the end of the weight to the marker was 48 feet and the zero of the gage was 6 feet from the center of the pulley. The zero of the gage was 40.9 feet below bench mark No. 1, described below. On June 18, 1896, a new wire gage

was placed on the lower side of the first span of the bridge. The zero of the gage was changed to 41.3 feet below bench mark No. 1, the wire length being 44.19 feet. During 1896 and 1897 the wire became rusted and broke frequently; the changes in wire length were not recorded. January 25, 1898, a new wire was put in, the length being 44.22 feet, and this length has been maintained since that date, the datum elevation continuing at 41.3 feet below bench mark No. 1.

During the period between the measurements of April 16 and July 29, 1901, a large quantity of earth excavated from the canal was thrown into the river along its left bank, changing the section and possibly affecting the flow of the river. The shifting of this material necessitated moving the gage farther from the shore. This was done by the observer, who attempted to install a temporary gage to read the same as the old one. The indications are, however, that the gage was not set to read exactly the same, and the gage heights between April 16, 1901, and September 2, 1902, are somewhat in error.

A standard boxed chain gage was installed at this station September 2, 1902. It is bolted to the hand rail on the lower side of the bridge on the first span from the left bank. The length of the chain is 44.22 feet, the same length as had been previously used. In placing the box, however, the center of the pulley was raised 0.45 foot, making elevation of the bench mark above gage datum 41.75 feet, instead of 41.3 feet. The gage is read once each day by George H. Hickman. Bench mark No. 1, established November 16, 1896, is a copper bolt in a large capstone on the lower wing wall of the north abutment, about 10 feet from the north end of the first iron truss and 41.75 feet above the datum of the gage. Bench mark No. 2, established in July, 1904, is a cross chiseled on the lower step of the upstream wing wall on the left bank of the river, being just across the towpath, 15 feet from the canal. Its elevation is 24.00 feet above gage datum.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of Potomac River at Point of Rocks, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 13	Tillinghast and Comstock	1,164	8,600	3.33	6.56	28,640
June 20	Grover and Lyman	1,012	2,727	1.10	1.29	2,997
October 30	G. F. Harley	1,000	3,532	1.38	2.05	4,889
November 9	do	987	2,703	.94	1.20	2,531
Do	Harley and Stewart	987	2,703	.91	1.20	2,467

Discharge measurements of Chesapeake and Ohio Canal at Point of Rocks, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
October 30	Harley and Henshaw	45	243	0.324	[a]21.51	78.8
November 9	Harley and Stewart	45	236	.381	[a]21.51	90.0

[a] Elevation of water surface of canal above Potomac River gage datum determined with a level.

Daily gage height, in feet, of Potomac River at Point of Rocks, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.4	2.4	3.2	1.6	1.5	2.1	2.9	2.2	1.0	1.6	1.6
2	2.4	2.4	2.5	3.0	1.6	1.4	1.8	2.7	2.0	1.0	1.5	1.6
3	2.5	2.3	2.6	2.7	1.6	1.4	1.6	2.4	1.8	1.0	1.5	2.5
4	2.8	2.2	2.8	2.5	1.5	1.4	1.5	2.2	1.7	1.0	1.4	4.6
5	3.0	2.2	3.4	2.6	1.5	1.3	3.0	2.0	1.6	1.0	1.4	4.0
6	3.2	2.2	4.0	2.7	1.5	1.3	3.5	1.8	1.5	1.0	1.3	3.4
7	4.4	2.2	4.4	2.8	1.4	1.5	4.0	1.6	1.5	1.0	1.3	3.0
8	4.6	2.1	5.1	3.0	1.4	1.6	4.5	1.5	1.4	1.0	1.3	2.4
9	4.0	2.1	6.0	3.0	1.4	1.9	4.0	1.5	1.4	1.0	1.2	2.3
10	3.4	2.0	6.4	2.9	1.4	2.0	3.6	1.4	1.3	.9	1.2	2.2
11	3.0	2.0	11.0	2.8	1.4	1.9	2.8	1.4	1.3	.9	1.0	2.1
12	2.8	2.0	10.1	2.8	1.4	1.9	2.3	1.3	1.4	1.2	1.0	2.0
13	2.6	2.0	6.9	2.9	1.4	2.3	3.2	1.3	1.4	1.1	1.0	1.9
14	2.5	2.0	6.0	2.8	1.4	2.2	4.1	1.3	2.0	1.4	1.0	1.8
15	2.5	2.0	5.9	2.6	3.0	2.0	5.0	1.6	1.7	1.6	1.0	1.8
16	2.9	2.0	5.5	2.4	2.8	2.0	5.4	2.0	1.5	1.5	1.0	1.7
17	3.8	2.1	5.0	2.3	2.7	1.9	4.2	2.9	1.4	1.3	1.0	1.6
18	3.2	2.1	4.5	2.2	2.6	1.8	4.0	3.4	1.4	1.2	.9	1.5
19	2.8	2.1	4.4	2.1	2.5	1.6	3.6	2.5	1.4	1.0	.9	1.5
20	2.6	2.2	5.0	2.0	2.4	1.4	3.3	2.1	1.3	1.2	.9	1.5
21	2.6	2.2	5.9	2.0	2.3	1.3	3.0	1.8	1.3	1.4	.9	2.8
22	2.7	2.2	7.5	1.9	2.2	1.5	2.8	1.7	1.2	1.8	.9	7.6
23	2.8	2.2	8.4	1.9	2.2	2.5	2.6	1.5	1.2	1.6	.9	7.5
24	2.4	2.2	6.7	1.9	2.0	3.6	4.0	1.5	1.2	1.4	.9	6.1
25	2.1	2.2	5.8	1.9	1.8	5.2	3.5	2.0	1.2	1.4	.9	5.5
26	1.9	2.3	6.9	1.8	1.7	7.0	3.0	2.9	1.1	1.5	.9	4.8
27	3.0	2.3	5.9	1.8	1.6	5.0	2.6	3.4	1.1	1.6	.9	4.1
28	2.6	2.4	5.2	1.7	1.5	3.6	2.3	3.9	1.1	1.7	.9	3.4
29	2.6	.....	4.6	1.7	1.5	3.0	2.0	2.9	1.1	2.1	.9	3.1
30	2.5	.....	4.0	1.7	1.4	2.6	1.8	2.8	1.0	2.0	1.3	3.0
31	2.5	.....	3.6	.....	1.3	.....	2.5	2.5	.....	1.8	.....	3.2

NOTE.—January 27, rise caused by ice gorge.

Station rating table for Potomac River at Point of Rocks, Md., from April 1, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	900	2.40	6,520	4.60	17,430	8.40	42,980
.60	1,090	2.50	6,920	4.80	18,610	8.60	44,500
.70	1,295	2.60	7,330	5.00	19,820	8.80	46,040
.80	1,515	2.70	7,750	5.20	21,060	9.00	47,600
.90	1,750	2.80	8,180	5.40	22,300	9.20	49,160
1.00	2,000	2.90	8,620	5.60	23,560	9.40	50,760
1.10	2,260	3.00	9,070	5.80	24,840	9.60	52,360
1.20	2,530	3.10	9,530	6.00	26,140	9.80	53,960
1.30	2,810	3.20	10,000	6.20	27,460	10.00	55,600
1.40	3,100	3.30	10,480	6.40	28,780	11.00	63,900
1.50	3,400	3.40	10,970	6.60	30,100	12.00	72,200
1.60	3,700	3.50	11,470	6.80	31,460	13.00	80,500
1.70	4,010	3.60	11,980	7.00	32,820	14.00	88,800
1.80	4,330	3.70	12,490	7.20	34,220	15.00	97,100
1.90	4,670	3.80	13,010	7.40	35,620	16.00	105,400
2.00	5,020	3.90	13,530	7.60	37,060	17.00	113,700
2.10	5,380	4.00	14,070	7.80	38,500	18.00	122,000
2.20	5,750	4.20	15,150	8.00	39,980	19.00	130,300
2.30	6,130	4.40	16,270	8.20	41,460	20.00	138,600

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905, inclusive. It is fairly well defined between gage heights 1 foot and 14 feet. The table has been extended beyond these limits. Above gage height 10 feet the rating curve is a tangent, the difference being 830 per tenth. The above table supersedes previous tables, from April 1, 1902, to December 31, 1905.

Estimated monthly discharge of Potomac River at Point of Rocks, Md., 1902–1905.

[Drainage area, 9,654 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
January	75,110	7,580	17,520	1.81	2.09
February	203,800	9,020	32,520	3.37	3.51
March	218,700	14,700	54,410	5.64	6.50
April	108,700	7,750	28,760	2.99	3.34
May	9,530	4,670	5,973	.619	.714
June	4,330	2,530	3,186	.330	.368
July	4,330	2,000	3,086	.320	.369
August	4,330	1,515	2,464	.255	.294
September	2,000	1,295	1,490	.154	.172
October	5,380	1,515	2,767	.287	.331
November	11,470	1,750	2,837	.294	.328
December	54,780	7,330	18,970	1.96	2.26
The year	218,700	1,295	14,500	1.50	20.28

Estimated monthly discharge of Potomac River at Point of Rocks, Md., 1902–1905—Cont'd.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
January	68,880	6,520	17,200	1.78	2.05
February	49,160	12,490	22,190	2.30	2.40
March	99,590	9,070	26,730	2.77	3.19
April	97,930	9,530	28,900	2.99	3.34
May	9,070	4,330	6,212	.643	.741
June	73,860	6,520	17,970	1.86	2.08
July	45,260	4,330	12,760	1.32	1.52
August	8,620	2,810	4,826	.500	.576
September	16,850	2,530	4,669	.484	.540
October	6,130	2,000	3,212	.333	.384
November	2,810	2,000	2,175	.225	.251
December	4,010	2,000	2,926	.303	.349
The year	99,590	2,000	12,480	1.29	17.42
1904.					
January	35,620	3,400	7,287	.755	.870
February	37,060	8,620	17,480	1.81	1.95
March	22,300	5,380	11,170	1.16	1.34
April	28,120	3,400	7,406	.767	.856
May	27,460	5,380	9,362	.970	1.12
June	38,500	3,100	10,160	1.05	1.17
July	10,970	2,530	4,510	.467	.538
August	3,400	1,750	2,394	.248	.286
September	2,000	1,295	1,592	.165	.184
October	2,000	900	1,164	.121	.140
November	1,515	1,090	1,340	.139	.155
December	5,020	1,515	2,201	.228	.263
The year	38,500	900	6,339	.657	8.87
1905.					
January	17,430	4,670	8,626	.894	1.03
February	6,520	5,020	5,625	.583	.607
March	63,900	6,520	23,480	2.43	2.80
April	10,000	4,010	6,581	.682	.761
May	9,070	2,810	4,493	.465	.536
June	32,820	2,810	6,579	.681	.760
July	22,300	3,400	10,190	1.06	1.22
August	13,530	2,810	5,830	.604	.696
September	5,750	2,000	3,205	.332	.370
October	5,380	1,750	2,888	.299	.345
November	3,700	1,750	2,267	.235	.262
December	37,060	3,400	10,640	1.10	.127
The year	63,900	1,750	7,534	.780	10.66

NOTE.—1902, 1903, 1905, ice conditions existed during portions of the winter months; 1904, ice conditions during portions of January and February. Discharge applied as for open channel throughout the winter months.

Estimates January to August, 1902, liable to error.

SOUTH BRANCH POTOMAC RIVER NEAR SPRINGFIELD, W. VA.

A gaging station was established at the Baltimore and Ohio Railroad bridge, 3 miles southwest of Springfield, by C. C. Babb, in April, 1894. This station was discontinued in 1896 for want of an observer. On June 26, 1899, a station was established by E. G. Paul at the highway bridge 1.5 miles below the original station, near Grace station. This bridge was carried away by flood in February, 1902. The present station was established August 28, 1903, by E. G. Paul. It is located at the steel highway bridge 2.5 miles east of Springfield, W. Va.

The channel is straight for several hundred feet above and below the station. Both banks are low and liable to overflow. The bed of the stream is of gravel. The bridge has two spans of 150 feet each. During high water the river flows beneath both spans, but at low stages beneath the left span only. There is a dam about 2 miles above the station, and a small island above and also one below.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the river face of the left abutment at the downstream side of the bridge.

A standard chain gage is located in the center of the left span on the downstream side of the bridge. The length of the chain from the end of the weight to the marker is 37.59 feet. The gage is read twice each day by James R. Blue. Bench mark No. 1 is a nail in a large sycamore tree 15 feet downstream from the left approach to the bridge. The nail is in the side of the tree away from the river and about 6 feet above the ground. Its elevation is 18.80 feet above gage datum. Bench mark No. 2 is a nail in a large willow tree on the left bank of the river about 65 feet upstream from the bridge. It is on the side of the tree away from the river and about 2.5 feet above the ground. Its elevation is 14.52 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water Supply Paper):

Description: Ann 18, iv, pp 19-20; Bull 131, p 88; 140, pp 43-44; WS 35, p 85; 48, p 116; 65, p 229; 82, p 170; 97, pp 320-321; 126, p 66.

Discharge: Ann 18, iv, p 20; 19, iv, p 134; Bull 140, p 44; WS 35, p 85; 48, p 116; 65, p 229; 82, p 170; 97, p 321; 126, p 66.

Discharge, monthly: Ann 18, iv, p 21; 20, iv, p 120; Bull 140, p 45; WS 75, pp 34-35.

Gage heights: Bull 131, p 88; 140, p 45; WS 35, p 85; 48, p 117; 65, p 230; 97, p 321; 126, p 67.

Rating table: Ann 18, iv, p 21; Bull 140, p 44; WS 65, p 318.

Water powers: Ann 19, iv, pp 134-135.

Discharge measurements of South Branch Potomac River near Springfield, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 29	E. C. Murphy	162	619	3.68	4.48	2,283
April 24	A. H. Horton	147	385	1.94	3.02	746
June 8	R. M. Packard	145	393	1.99	3.11	781
November 6	Hanna and Grieve	144	284	.99	2.30	282

Mean daily gage height, in feet, South Branch of Potomac River near Springfield, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	2.9	4.1	3.55	2.9	2.9	3.55	2.9	2.7	2.0	2.4	2.3
2	2.45	2.9	3.9	3.35	2.9	3.0	3.7	2.75	2.6	2.0	2.35	2.3
3	2.3	2.9	3.8	3.3	2.8	2.95	3.45	2.6	2.5	2.0	2.3	3.2
4	2.45	2.9	3.4	3.1	2.8	2.75	4.15	2.6	2.5	2.0	2.2	5.15
5	2.55	2.9	3.7	3.1	2.7	2.7	3.8	2.5	2.4	2.0	2.2	4.35
6	2.35	3.0	4.55	4.0	2.7	2.7	5.35	2.5	2.4	2.0	2.2	3.9
7	2.3	3.0	4.9	4.7	2.7	2.7	4.35	2.65	2.3	2.0	2.2	3.5
8	2.2	3.0	5.25	4.55	2.8	3.0	3.9	2.65	2.25	2.0	2.2	3.2
9	2.3	3.1	7.05	4.2	2.8	2.75	3.65	2.55	2.2	2.0	2.2	3.05
10	2.4	3.1	11.1	3.95	2.8	2.65	3.35	2.5	2.25	2.0	2.2	2.95
11	2.4	3.1	8.75	3.9	2.8	2.6	3.4	2.85	2.45	2.0	2.2	2.85
12	2.3	3.1	7.25	3.8	3.85	2.65	3.85	2.85	2.45	2.0	2.1	2.7
13	4.7	3.1	6.15	3.5	7.5	2.65	4.85	2.5	2.3	2.0	2.1	2.65
14	6.05	3.1	5.35	3.35	5.8	2.55	5.95	3.6	2.4	2.25	2.1	2.55
15	4.75	3.1	4.9	3.3	7.55	2.45	5.6	4.4	2.45	2.2	2.1	2.45
16	3.6	3.1	4.75	3.2	7.05	2.4	4.75	3.9	2.3	2.1	2.1	2.55
17	3.2	3.1	4.75	3.2	5.75	2.3	3.9	3.4	2.2	2.0	2.1	2.6
18	3.1	3.1	5.25	3.1	4.9	2.3	3.5	3.1	2.2	2.0	2.1	2.5
19	3.15	3.1	5.55	3.0	4.3	2.3	3.25	3.0	2.1	2.0	2.1	2.4
20	3.2	3.1	5.9	3.0	4.0	2.2	3.05	2.95	2.1	2.1	2.1	2.35
21	3.3	3.1	7.1	2.9	3.6	2.55	3.2	2.75	2.0	2.1	2.1	6.1
22	3.2	3.1	10.05	2.9	3.45	3.9	3.25	2.7	2.0	2.15	2.1	9.45
23	3.2	3.1	7.55	2.9	3.25	6.0	3.95	2.6	1.9	2.25	2.1	7.75
24	3.05	3.1	6.15	2.8	3.05	9.2	5.2	2.55	1.9	2.3	2.1	7.05
25	3.0	3.1	7.25	2.7	2.95	8.55	4.15	4.0	1.9	2.45	2.1	6.15
26	2.85	3.8	6.2	2.7	2.9	5.9	3.55	5.65	1.8	2.55	2.1	5.65
27	2.7	3.9	5.4	2.8	2.8	6.85	3.3	4.2	1.8	2.9	2.1	5.2
28	2.5	4.1	4.8	2.8	2.8	5.8	3.0	3.35	1.8	3.25	2.1	4.65
29	3.0	.....	4.3	2.6	2.7	4.45	3.0	3.0	1.8	2.65	2.1	4.05
30	2.9	.....	4.0	2.9	2.7	3.85	3.85	2.8	2.0	2.55	2.2	4.4
31	2.5	.....	3.85	.....	2.6	.....	3.1	2.7	.....	2.45	.....	4.6

NOTE.—February 1, river frozen over.

Station rating table for South Branch Potomac River near Springfield, W. Va., from August 28, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	78	2.90	630	4.00	1,672	5.10	3,195
1.90	96	3.00	702	4.10	1,790	5.20	3,355
2.00	125	3.10	778	4.20	1,912	5.30	3,520
2.10	163	3.20	860	4.30	2,038	5.40	3,690
2.20	210	3.30	947	4.40	2,168	5.50	3,860
2.30	261	3.40	1,039	4.50	2,302	5.60	4,030
2.40	315	3.50	1,135	4.60	2,440	5.70	4,205
2.50	372	3.60	1,235	4.70	2,582	5.80	4,380
2.60	432	3.70	1,339	4.80	2,728	5.90	4,560
2.70	495	3.80	1,447	4.90	2,879	6.00	4,745
2.80	561	3.90	1,558	5.00	3,035		

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1903–1905. It is fairly well defined between gage heights 2 feet and 4.5 feet. The table has been extended beyond these limits. Above 6 feet gage height the discharge is estimated.

Estimated monthly discharge of South Branch Potomac River near Springfield, W. Va., for 1903–1905.

[Drainage area, 1,475 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September	702	210	327	0.222	0.248
October	432	163	271	.184	.212
November	261	163	206	.140	.156
December	495	163	290	.197	.227
1904.					
January	12,150	432	1,009	.684	.789
February	5,540	432	1,004	.681	.734
March	4,030	740	1,451	.984	1.13
April	10,930	495	1,660	1.13	1.26
May	9,500	702	2,143	1.45	1.67
June	4,118	402	1,121	.760	.848
July	2,302	315	568	.385	.444
August	561	96	238	.161	.186
September	210	78	123	.083	.093
October	96	78	80.9	.055	.063
November	96	78	79.9	.054	.060
December	1,558	78	296	.200	.231
The year	12,150	78	814	.552	7.51
1905.					
January	4,840	210	821	.557	.642
February	1,790	630	831	.563	.586
March	18,300	1,039	4,793	3.25	3.75
April	2,582	432	1,015	.688	.768
May	8,245	432	1,744	1.18	1.36
June	12,600	210	1,948	1.32	1.47
July	4,652	702	1,673	1.13	1.30
August	4,118	372	854	.579	.668
September	495	78	228	.155	.173
October	904	125	229	.155	.179
November	315	163	190	.129	.144
December	13,350	261	2,298	1.56	1.80
The year	18,300	78	1,385	.939	12.84

NOTE.—Ice conditions unknown; discharge applied as for open channel.

SAVAGE RIVER AT BLOOMINGTON, MD.

Savage River rises in the northwestern part of Allegany County, Md., flows southwest, then south, uniting with Potomac River near Bloomington.

The gaging station was established May 3, 1905. It is located at a highway bridge about 800 feet above the junction of Savage River with North Branch of the Potomac.

The channel is straight for 200 feet above and below the station. The current is swift. The right bank is low, clean, and has an overflow channel at high water. The left bank is high and does not overflow. The bed of the stream is rocky, very irregular, and permanent. There is but one channel at low and ordinary stages; during high-water stages there are two channels.

Discharge measurements are made from the downstream side of the steel bridge to which the gage is fastened. The initial point for soundings is the center of the bridge pier at the left abutment, downstream side.

A standard chain gage is attached to the downstream side of the bridge near the left abutment. The length of the chain from the end of the weight to the marker is 21.19 feet. During 1905 the gage was read twice each day by F. S. Cline. Bench mark No. 1 is a chiseled cross on the downstream corner of the left abutment. Its elevation is 16.49 feet above gage datum. Bench mark No. 2 is a circular chisel draft on a large rock on the fence line about 100 feet north of bench mark No. 1. Its elevation is 18.88 feet above gage datum. Bench mark No. 3 is the top of the eyebar of the lower chord 5 feet from the initial point for soundings, on the downstream side of the bridge. Its elevation is 16.88 feet above gage datum. Bench mark No. 4 is the top of the pulley wheel of the gage. Its elevation is 20.86 feet above gage datum.

Discharge measurements of Savage River at Bloomington, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 18	N. C. Grover	36	63	1.41	2.96	89
May 4	Tillinghast and Soper	38	66	1.08	2.68	72
June 7	R. H. Bolster	34	66	1.23	2.88	81
July 17	N. C. Grover	29	45	.82	2.47	37
November 7	Hanna and Grieve	34	66	1.01	2.59	66

Mean daily gage height, in feet, of Savage River at Bloomington, Md., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.8	2.32	2.6	2.18	1.98	2.82	3.58
2	.....	2.72	3.3	2.42	2.20	2.12	2.78	3.92
3	2.7	2.62	2.92	2.22	2.13	2.08	2.62	5.22
4	2.7	2.52	2.82	2.12	2.12	2.15	2.55	4.58
5	2.62	2.52	2.72	2.05	1.9	2.05	2.5	4.28
6	2.62	2.42	2.48	2.1	1.88	1.9	2.58	3.7
7	2.62	2.97	3.62	1.92	1.85	1.9	2.58	3.52
8	2.58	3.42	4.32	1.85	1.7	1.8	2.48	3.35
9	2.5	3.22	3.75	1.9	1.9	1.85	2.52	3.18
10	2.45	2.92	3.52	1.85	1.78	1.78	2.42	3.25
11	2.4	3.93	3.38	1.85	4.48	2.22	2.4	2.88
12	2.78	4.55	3.1	2.25	3.85	2.75	2.35	2.88
13	2.7	4.25	2.92	2.08	3.4	2.48	2.28	2.82
14	3.0	3.75	2.88	1.95	3.08	2.42	2.25	2.72
15	4.15	3.4	2.72	2.05	2.75	2.32	2.22	2.62
16	3.92	3.18	2.52	2.45	2.58	2.22	2.42	2.45
17	3.75	2.92	2.4	2.22	2.52	2.18	2.32	2.82
18	3.65	2.78	2.32	2.19	2.45	2.02	2.25	2.65
19	3.48	2.68	2.28	2.15	2.42	2.1	2.22	2.52
20	3.25	2.72	2.4	2.05	2.28	4.42	2.2	2.65
21	3.1	2.78	2.28	2.05	2.18	3.75	2.08	3.75
22	2.92	2.6	2.22	1.95	2.12	3.28	1.92	4.52
23	2.78	2.52	2.6	1.82	2.05	3.05	2.05	4.48
24	2.62	2.85	2.35	1.85	2.3	2.92	2.22	4.25
25	2.6	2.82	2.18	3 05	1.9	2.85	2.28	3.9
26	2.6	2.68	2.18	3.55	1.9	3.55	2.2	3.7
27	2.6	2.8	2.02	2.92	1.95	3.6	2.12	3.48
28	2.48	2.58	1.9	2.68	1.9	3.48	2.1	2.78
29	2.4	2.48	2.15	2.62	1.9	3.35	3.42	3.4
30	2.4	2.32	2.62	2.48	1.85	2.7	4.2	2.2
31	2.5	.....	2.82	2.32	.....	2.92	.....	2.15

GEORGES CREEK AT WESTERNPORT, MD.

This station was established May 4, 1905. It is located at a highway bridge in Westernport, Md., about one-half mile above the mouth of the creek.

Above the station the channel is straight for about 50 feet and then makes a sharp bend; below the station it is straight for 300 feet. The current is swift. Both banks are fairly high, clean, and do not overflow. The bed of the stream is rocky and shifting. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the bridge to which the gage is attached. The initial point for soundings is the inside face of the left abutment, upstream side.

A standard chain gage is attached to the middle of the upstream side of the bridge. The length of the chain from the end of the weight to the marker is 16.23 feet. During 1905 the gage was read twice each day by G. A. Biggs. Bench mark No. 1 is the top of the downstream bedplate at the left abutment, on the downstream corner toward the railroad track. Its elevation is 11.58 feet above the datum of the gage. Bench mark No. 2 is the top of the eyebar on the upstream side of the bridge, 34 feet from the left abutment. Its elevation is 12.39 feet above the datum of the gage. Bench mark No. 3 is the top of the pulley wheel of the gage. Its elevation is 15.88 feet above the datum of the gage.

Discharge measurements of Georges Creek at Westernport, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 4	Tillinghast and Soper	41	30	1.08	1.35	33
June 7	R. H. Bolster	44	49	2.70	1.98	131
July 17	N. C. Grover	43	16	2.71	1.58	43
April 18	do	38	26	2.04	1.60	53
November 7	Murphy and Hanna	24	18	2.43	1.35	45

Mean daily gage height, in feet, of Georges Creek at Westernport, Md., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.45	1.38	1.22	1.05	0.95	1.5	1.62
2		1.45	1.58	1.12	1.05	1.28	1.5	1.8
3		1.38	1.22	1.1	1.08	1.18	1.45	2.35
4	1.45	1.3	1.48	1.1	1.12	1.1	1.38	2.22
5	1.4	1.25	1.52	1.08	1.1	1.05	1.4	2.12
6	1.42	1.2	1.48	1.05	1.1	1.02	1.52	2.55
7	1.5	1.98	3.45	1.05	1.05	1.0	1.4	2.35
8	1.4	1.58	3.38	1.05	1.0	1.0	1.32	2.22
9	1.35	1.42	2.65	1.05	1.0	1.0	1.25	2.12
10	1.38	1.35	2.15	1.05	1.28	.98	1.2	2.02
11	1.38	2.05	2.05	1.08	2.55	1.75	1.12	1.9
12	1.5	1.98	1.98	1.12	1.9	1.55	1.1	1.88
13	1.38	1.85	1.92	1.15	1.65	1.25	1.05	1.82
14	1.48	1.72	1.8	1.12	1.5	1.12	1.0	1.78
15	1.72	1.62	1.7	1.28	1.42	1.08	.95	1.42
16	1.68	1.52	1.62	1.25	1.32	1.05	.98	1.45
17	1.65	1.5	1.52	1.12	1.38	1.0	1.0	1.3
18	1.62	1.48	1.42	1.05	1.28	1.0	1.0	1.3
19	1.58	1.4	1.32	1.02	1.22	1.18	1.02	1.35
20	1.52	1.55	1.4	1.0	1.18	2.3	1.02	1.4
21	1.5	1.48	1.38	1.0	1.12	1.65	1.0	3.4
22	1.45	1.42	1.35	1.0	1.1	1.52	1.0	3.08
23	1.4	1.38	1.7	.98	1.05	1.48	1.0	2.2
24	1.38	1.5	1.48	.92	1.05	1.42	1.0	2.2
25	1.28	1.55	1.22	1.72	1.0	1.52	1.08	2.12
26	1.28	1.4	1.18	1.65	1.0	2.02	1.05	2.15
27	1.25	1.32	1.15	1.45	1.0	1.85	1.08	1.98
28	1.3	1.25	1.15	1.25	1.0	1.72	1.1	1.95
29	1.3	1.22	1.2	1.1	.95	1.62	1.55	2.08
30	1.28	1.2	1.45	1.12	.95	1.52	1.65	1.88
31	1.32		1.38	1.08		1.5		1.75

WILLS CREEK AT CUMBERLAND, MD.

This station was established May 5, 1905. It is located at the highway bridge at the upper end of "The Narrows," Cumberland, Md.

The channel is straight for 200 feet above and 500 feet below the station. The current is fairly swift. Both banks are high and do not overflow. The bed of the stream is rocky, very rough, and permanent. There are two channels at all but very low stages.

Discharge measurements are made from the downstream side of the two-span steel bridge to which the gage is fastened. The initial point for soundings is the face of the right abutment.

A standard chain gage is fastened to the downstream side of the bridge, near the middle of the right span. The length of the chain from the end of the weight to the marker is 26.98 feet. During 1905 the gage was read twice each day by H. E. McKenzie. Bench mark No. 1 is a square chisel draft on the top of the bridge-seat stone at the downstream side of the right abutment. Its elevation is 21.88 feet above the datum of the gage. Bench mark No. 2 is the top of the pulley wheel of the gage. Its elevation is 26.65 feet above the datum of the gage. Bench mark No. 3 is top of horizontal of second projecting piece from right bank, downstream side of bridge. Its elevation is 23.40 feet above the datum of the gage.

Discharge measurements of Wills Creek at Cumberland, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 17	N. C. Grover	78	233	1.01	4.20	236
May 6	Tillinghast and Soper	83	217	.60	3.72	130
June 8	R. M. Packard	80	254	.98	4.22	248
November 6	E. C. Murphy	68	201	.65	3.68	130

Mean daily gage height, in feet, of Wills Creek at Cumberland, Md., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.72	3.65	3.55	3.62	3.05	3.92	4.52
2		3.95	4.0	3.45	3.55	3.2	3.8	4.38
3		3.82	3.75	3.4	3.6	3.35	3.75	7.08
4		3.7	3.65	3.3	3.55	3.3	3.75	6.22
5		3.68	3.6	3.3	3.45	3.18	3.65	5.45
6	3.7	3.6	3.58	3.28	3.38	3.08	3.65	5.02
7	4.0	4.2	6.58	3.2	3.32	3.0	3.65	4.7
8	3.82	4.25	6.7	3.18	3.22	3.0	3.6	4.5
9	3.8	4.05	5.7	3.15	3.2	3.0	3.6	4.38
10	3.8	3.9	5.42	3.08	3.18	3.0	3.55	4.25
11	3.8	6.2	5.05	3.1	5.25	4.05	3.5	4.05
12	4.08	5.42	4.7	3.8	5.0	4.0	3.45	4.02
13	3.98	4.88	4.6	3.48	4.6	3.72	3.42	3.98
14	4.05	4.48	4.98	3.45	4.15	3.55	3.4	3.8
15	5.42	4.25	4.58	5.85	3.98	3.42	3.35	3.55
16	5.08	4.52	4.32	4.85	3.82	3.4	3.38	3.42
17	4.85	3.9	4.1	4.35	3.72	3.32	3.45	3.32
18	4.6	3.9	3.85	4.02	3.78	3.3	3.4	3.68
19	4.45	3.9	3.82	3.85	3.68	3.3	3.35	3.92
20	4.28	3.7	4.25	3.72	3.55	5.15	3.3	3.75
21	4.1	4.05	3.88	3.68	3.45	4.65	3.25	6.6
22	4.0	4.15	3.88	3.52	3.4	4.38	3.2	6.25
23	3.92	4.32	4.32	3.42	3.32	4.15	3.25	5.8
24	3.82	4.45	3.98	3.32	3.28	4.02	3.3	5.32
25	3.72	4.5	3.8	5.10	3.18	3.9	3.35	5.0
26	3.62	4.38	3.68	4.58	3.15	4.45	3.3	4.75
27	3.98	4.3	3.6	4.18	3.10	4.25	3.25	4.55
28	3.7	4.02	3.55	3.98	3.10	4.18	3.25	4.35
29	3.6	3.9	3.6	3.82	3.05	4.12	5.1	5.22
30	3.52	3.72	3.85	4.08	3.05	4.02	4.88	5.05
31	3.52	.....	3.65	3.72	.....	4.0	.....	4.65

OPEQUON CREEK NEAR MARTINSBURG, W. VA.

This station was established May 8, 1905. It is located at the highway bridge known as "Rileys Ford Bridge," about 4 miles southeast of Martinsburg, W. Va.

The channel is straight for about 300 feet above and below the station. The current is swift. Both banks are clean. The right bank is high and does not overflow. The left bank has a flood plain extending 600 feet across a level meadow. The bed of the stream is rocky, very rough, free from vegetation, and permanent. There is but one channel at ordinary stages. The stream is liable to extreme fluctuations at high water, covering the entire flood plain on the west.

Discharge measurements are made from the downstream side of the steel bridge to which the gage is attached. The initial point for soundings is the top face of the left abutment, downstream side.

A standard chain gage is fastened to the downstream side of the bridge near the left abutment. The length of the chain from the end of the weight to the marker is 19.90 feet. During 1905 the gage was read twice each day by Frank Mose. Bench mark No. 1 is a cross chiseled on the upstream left abutment. Its elevation is 18.44 feet above the datum of the gage. Bench mark No. 2 is the top of the pulley wheel of the gage. Its elevation is 19.54 feet above the datum of the gage. Bench mark No. 3 is a mark on the downstream steel angle guard rail, about 7 feet from the initial point for soundings. Its elevation is 19.51 feet above the datum of the gage.

Discharge measurements of Opequon Creek near Martinsburg, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 7	Tillinghast and Soper	48	51	2.77	1.33	141
November 8	E. C. Murphy	53	34	1.88	1.25	63

Mean daily gage height, in feet, of Opequon Creek near Martinsburg, W. Va., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.32					1.2	1.28
2		1.28					1.18	1.2
3		1.22					1.15	2.45
4		1.2					1.12	2.32
5							1.1	1.78
6							1.1	1.38
7							1.1	1.3
8						1.15	1.15	1.28
9	1.35					1.12	1.12	1.2
10	1.38					1.1	1.1	1.22
11	1.38					1.2	1.12	1.2
12	1.38					1.28	1.5	1.2
13	1.32					1.22	1.5	1.2
14	1.4					1.18	1.5	1.18
15	1.98					1.12	1.5	1.1
16	1.72					1.1	1.5	1.22
17	1.52					1.1	1.5	1.35
18	1.42					1.3	1.1	1.38
19	1.38					1.5	1.1	1.2
20	1.32					1.38	1.1	1.2
21	1.28					1.32	1.1	7.62
22	1.25					1.25	1.1	7.3
23	1.25					1.18	1.1	3.8
24	1.22					1.12	1.1	2.92
25	1.18					1.18	1.1	2.5
26	1.15					2.0	1.1	2.18
27	1.18					1.68	1.1	2.2
28	1.2					1.42	1.1	1.8
29	1.18					1.38	1.5	3.1
30	1.15					1.3	1.52	2.55
31	1.22					1.22		2.0

TUSCARORA CREEK AT MARTINSBURG, W. VA.

This station was established May 8, 1905. It is located at the dam formerly used to impound water for the use of the city of Martinsburg, W. Va.

The channel is curved for 20 feet above the dam and straight for 200 feet beyond this point. The channel below is a steep race way from the crest of the dam, paved with riprap. The current is swift. Both banks are low, clean, and not liable to overflow. The bed of the stream above the dam is fairly uniform and shallow, with a mud bottom. There is but one channel at all stages. The stream is liable to small fluctuations, owing to the varying demands of factories above the station. The water level at the gage is somewhat unsteady. The velocity of approach is high.

The discharge is determined by applying the weir formula to the flow over the crest of the dam.

A vertical staff gage is bolted to the upstream face of the left abutment, the zero being set at the level of the floor of the spillway. During 1905 the gage was read twice each day by B. N. Martin. Bench mark No. 1 is the crest of the dam at the left corner; elevation, 0.04 foot below the gage datum. Bench mark No. 2 is the crest of the dam at the right corner; elevation 0.04 foot above the gage datum.

Owing to poor conditions this station was abandoned December 31, 1905.

Discharge measurement of Tuscarora Creek at Martinsburg, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 9	R. C. Soper	20	14.3	1.76	.78	25.2

Mean daily gage height, in feet, of Tuscarora Creek at Martinsburg, W. Va., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.72	0.6	1.55	0.68	0.75	0.85	0.55
2		.64	.7	1.75	.75	.82	.9	.65
3		.62	.72	1.65	.85	.70	.88	1.45
4		.65	.75	1.7	.75	.85	.88	.85
5		.62	.68	1.75	.65	.75	.8	.65
6		.61	.85	1.75	.6	.68	.85	.55
7		.9	.82	1.3	.58	.75	.88	.55
8	0.75	.68	.72	1.4	.7	.78	.6	.55
9	.8	.62	.78	1.3	.55	.68	.58	.55
10	.8	.62	.78	1.25	.6	.65	.55	.55
11	.74	.6	.85	.88	.58	.55	.58	.58
12	.75	.18	1.45	.88	.7	.55	.58	.55
13	.72	.5	2.65	.85	.65	.78	.55	.58
14	.75	.7	3.0	.78	.55	.68	.55	.58
15	.82	.68	2.35	.92	.55	.65	.58	.65
16	.76	.72	1.15	.78	.55	.70	.6	.7
17	.8	.65	.85	.8	.65	.78	.52	.58
18	.78	.75	.82	1.25	.55	.68	.55	.68
19	.75	.78	.78	1.02	.55	.72	.5	.65
20	.72	.72	.78	1.05	.6	.65	.52	.75
21	.72	.78	.68	1.02	.65	.58	.55	.88
22	.74	.8	.7	1.1	.6	.75	.52	2.15
23	.72	.72	1.02	1.08	.55	.75	.58	1.8
24	.74	.28	1.45	1.5	.55	.68	.5	1.25
25	.68	.14	1.25	1.15	.55	.58	.58	1.0
26	.62	.42	1.1	.98	.48	.65	.55	.75
27	.6	.72	1.6	1.35	.48	.68	.62	.65
28	.6	.75	1.5	2.0	.75	.58	.65	.7
29	.62	.72	1.85	.85	.65	.85	.55	.75
30	.59	.68	1.55	.8	.75	.92	.5	.7
31	.78	.....	1.55	.7	.....	.82	.....	.....

ANTIETAM CREEK NEAR SHARPSBURG, MD.

Antietam Creek rises in the western part of Maryland, flows southward, and enters the Potomac 10 miles above Harpers Ferry. Its drainage area is hilly in character and is largely under cultivation.

The gaging station was established June 24, 1897, by A. P. Davis. It is located a few hundred feet below the bridge on the toll road from Sharpsburg to Keedysville, Md. There is an old dam, not now in use, just below the bridge.

The channel is straight for 300 feet above and below the station. It has a width at ordinary stages of about 100 feet, and is shallow and unobstructed. There is a good measurable velocity at all stages. The right bank is low and liable to overflow; the left bank is high and rocky, and both are fringed with trees. The bed of the stream is composed of gravel, is free from vegetation, and is permanent. There is but one channel at all stages.

Discharge measurements were made from a steel-wire cable, which is supported by the forks of a sycamore tree on each bank and is anchored to timbers set in the ground. A tagged wire is suspended above the cable. The initial point for soundings is a staple in the tree on the left bank.

The gage was a vertical rod driven into the gravel of the stream bed and spiked to a tree on the left bank near the cable. It was read once each day by Charles E. Hammond, the toll gatherer. The bench mark is a copper bolt set in a ledge of rock on the left bank at a point about 125 feet above the cable. Its elevation is 16.34 feet above gage datum.

This station was discontinued August 26, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report, WS=Water-Supply Paper):

Description: Ann 19, iv, pp 148-149; WS 15, p 16; 27, p 10; 35, p 86; 48, p 117; 65, p 230; 82, p 170; 97, pp 318-319; 126, pp 67-68.

Discharge: Ann 19, iv, pp 148-149; WS 15, p 16; 27, p 23; 35, p 86; 48, p 117; 65, p 230; 82, p 170; 97, p 319; 126, p 68.

Discharge, monthly: Ann 19, iv, p 149; 20, iv, pp 120, 122; 21, iv, p 95; 22, iv, p 134; WS 75, p 36; 82, p 172; 97, p 320; 126, p 69.

Discharge, yearly: Ann 20, iv, p 49.

Gage heights: WS 15, p 16; 27, p 19; 35, p 86; 48, p 118; 65, p 231; 82, p 171; 97, p 319; 126, p 68.

Hydrographs: Ann 19, iv, p 150; 20, iv, p 120; 21, iv, p 95; 22, iv, p 134.

Rating tables: Ann 19, iv, p 149; WS 27, p 24; 39, p 442; 52, p 511; 65, p 318; 82, p 171; 97, p 320; 126, p 69.

Mean daily gage height, in feet, of Antietam Creek near Sharpsburg, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	1.65	1.85	1.75	2.75	2.1	1.85	1.8	2.25
2	1.6	1.9	1.7	2.6	2.1	1.9	1.8	2.05
3	1.7	1.9	1.7	2.6	2.05	1.8	1.85	2.0
4	1.75	1.8	1.7	2.6	2.05	1.75	1.8	2.0
5	1.9	1.75	1.95	2.7	2.0	1.7	2.95	2.0
6	1.75	2.0	2.0	2.8	2.0	1.75	2.1	2.0
7	3.5	1.9	2.1	2.65	2.0	2.15	2.0	2.0
8	2.7	2.0	2.15	2.55	2.05	2.1	1.95	2.2
9	2.25	1.85	2.8	2.5	2.0	1.95	1.85	2.35
10	2.1	1.85	3.4	2.5	2.0	1.8	1.8	2.3
11	2.1	1.9	3.05	2.55	1.95	1.8	1.75	2.0
12	2.05	1.8	2.95	2.55	2.0	2.1	1.85	2.0
13	2.45	1.9	2.8	2.45	1.95	2.2	1.8	1.9
14	2.2	1.9	2.8	2.5	1.95	2.0	1.85	1.9
15	2.05	1.75	2.7	2.45	2.05	1.9	3.25	2.0
16	2.45	1.8	2.6	2.4	2.0	1.8	2.15	2.3
17	2.55	1.8	2.7	2.4	2.0	1.8	2.05	2.3
18	2.1	1.85	2.95	2.3	2.25	1.75	2.0	2.1
19	1.95	1.8	3.1	2.3	2.05	1.7	2.45	2.1
20	1.9	1.85	3.6	2.3	2.05	1.8	2.4	2.1
21	1.9	1.8	3.6	2.3	1.95	2.05	1.9	2.1
22	1.9	1.7	3.4	2.3	1.9	2.0	1.8	2.3
23	1.85	1.7	3.2	2.2	1.85	2.0	2.25	2.2
24	1.75	1.7	3.05	2.2	1.8	2.6	5.0	2.1
25	1.8	1.7	3.95	2.2	1.8	2.2	3.65	6.05
26	1.8	1.75	3.8	2.1	1.8	1.9	2.25	(a)
27	2.05	1.95	3.35	2.1	1.85	2.0	2.0	.....
28	2.0	1.85	3.1	2.1	1.8	1.95	2.0	.....
29	2.0	.....	3.0	2.1	1.85	1.95	2.0	.....
30	1.9	.....	2.9	2.1	1.9	1.85	2.65	.....
31	1.9	.....	2.8	.....	1.9	.....	2.45	.....

[a] Gage washed out August 26.

NOTE.—There was some ice at this station during February.

Station rating table for Antietam Creek near Sharpsburg, Md., from January 1, 1904, to August 26, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.35	90	2.20	265	3.10	615	4.00	1,105
1.40	95	2.30	298	3.20	665	4.20	1,215
1.50	108	2.40	332	3.30	720	4.40	1,325
1.60	121	2.50	367	3.40	775	4.60	1,435
1.70	137	2.60	402	3.50	830	4.80	1,545
1.80	155	2.70	440	3.60	885	5.00	1,655
1.90	179	2.80	482	3.70	940	6.00	2,205
2.00	205	2.90	525	3.80	995	7.00	2,755
2.10	234	3.00	570	3.90	1,050		

NOTE.—The above table is applicable only for open channel conditions. It is based on 12 discharge measurements made during 1898–1904. It is well defined between gage heights 1.6 feet and 3.5 feet. The table has been extended beyond these limits. Above gage heights 3.2 feet the rating curve is a tangent, the difference being 55 per tenth.

Estimated monthly discharge of Antietam Creek near Sharpsburg, Md., for 1905.

[Drainage area, 293 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,160	121	241	.823	.949
February[a]	206	155	179	.611	.636
March	1,215	137	500	1.71	1.97
April	482	234	335	1.14	1.27
May	332	155	204	.696	.802
June	332	137	186	.635	.708
July	1,655	155	293	1.00	1.15
August (1–25)	2,232	179	318	1.09	1.01

[a] No correction made in estimates for ice conditions during February.

SHENANDOAH RIVER AT MILLVILLE, W. VA.

Shenandoah River is formed by the junction of North and South forks at Riverton, Va., and flows in a northeasterly direction into West Virginia, where it empties into the Potomac at Harpers Ferry.

The Millville station was established April 15, 1895, by C. C. Babb. It is located about one-fourth mile above the Baltimore and Ohio Railroad station at Millville, W. Va. The highway runs within a few rods of the stream at the gaging station. The station is best reached by driving from Harpers Ferry, W. Va.

The channel is straight for several hundred feet above and below the station, and the current is swift and unobstructed. Both banks are low and liable to overflow. There is but one channel at all stages. The bed of the stream is composed of mud and rocks.

Discharge measurements are made from a three-fourths-inch cable, from which is suspended a car. The cable, which is suspended over the branches of two large sycamore trees and is securely anchored to the bank at both ends, has a total span of 500 feet. The initial point for soundings is the side of the tree to which the cable is attached on the left bank.

The vertical gage is spiked to a large sycamore tree on the left bank a few hundred feet downstream from the cable. The gage is read once each day by W. R. Nicewarner, the railroad station agent. Bench mark No. 1 is a copper plug in the upstream side of the

base of the second tree downstream from the gage. Its elevation is 6.68 feet above the zero of the gage. Bench mark No. 2 is the upper surface of the head of a wire nail driven horizontally in a blaze on the base of the first tree upstream from the gage. Its elevation is 7.42 feet above the zero of the gage. Bench mark No. 3 is the upper surface of the head of a wire nail driven in a blaze on the tree to which the gage is fastened, on the side away from the river. Its elevation is 9.43 feet above the zero of the gage.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of Shenandoah River at Millville, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 22	N. C. Grover	495	1,604	0.99	1.40	1,595
September 20	R. H. Bolster	482	1,325	.60	.84	799

Mean daily gage height, in feet, of Shenandoah River at Millville, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	1.4	3.35	2.2	1.2	1.2	1.9	2.1	1.15	0.6	0.7	0.6
2	.95	1.2	2.75	2.05	1.15	1.2	1.75	1.7	1.0	.55	.7	.6
3	.85	1.3	2.7	1.9	1.15	1.5	1.75	1.4	.95	.5	.65	.65
4	1.4	1.3	2.8	1.8	1.1	1.2	1.6	1.3	.9	.5	.65	.6
5	1.6	1.2	2.8	1.8	1.1	1.1	1.6	1.2	1.0	.5	.65	.6
6	1.55	1.2	4.1	2.0	1.0	1.0	1.6	1.1	1.05	.5	.65	.8
7	2.1	1.2	2.5	2.45	1.0	1.15	2.3	1.1	1.0	.5	.65	1.35
8	2.8	1.25	2.5	2.45	1.0	2.0	2.1	1.1	1.0	.5	.65	1.2
9	2.5	1.25	2.8	2.3	.95	1.2	2.3	1.1	.95	.5	.65	1.1
10	2.0	1.3	3.7	2.1	.95	1.0	2.1	1.05	.8	.5	.65	1.0
11	1.8	1.35	4.75	2.0	1.0	1.0	1.9	1.05	.8	.5	.6	.95
12	1.5	1.45	4.3	1.95	1.0	1.1	2.0	1.0	.85	.55	.6	.9
13	2.0	1.4	3.3	1.9	1.0	.9	2.8	.95	.8	.7	.6	.85
14	2.6	1.25	3.2	1.8	.95	.8	2.6	.95	.8	.7	.6	.8
15	2.9	1.25	2.9	1.7	2.0	.8	3.8	1.1	.8	.7	.6	.8
16	2.5	1.3	2.6	1.7	2.0	.75	5.3	1.1	.75	.7	.6	.8
17	2.0	1.55	2.4	1.65	2.1	.75	3.3	3.2	.8	.65	.6	.8
18	2.0	1.55	2.3	1.6	2.3	.7	2.7	2.3	.8	.65	.6	.8
19	2.0	1.5	2.2	1.5	2.1	.7	2.3	1.9	.85	.65	.55	.9
20	1.7	1.6	2.1	1.45	1.8	.7	2.0	1.5	.8	.65	.55	.9
21	1.6	1.55	2.4	1.4	1.7	.9	1.8	1.4	.8	.6	.6	2.3
22	1.5	1.5	2.7	1.4	1.5	3.3	1.8	1.3	.8	.6	.6	4.1
23	1.4	1.55	4.0	1.4	1.4	3.2	1.8	1.2	.8	.6	.6	5.3
24	1.3	1.6	3.4	1.35	1.3	3.5	2.8	1.1	.8	.6	.6	4.25
25	1.6	2.0	3.2	1.3	1.3	5.9	2.4	1.1	.75	.6	.6	3.6
26	1.6	2.2	3.6	1.2	1.2	4.8	2.2	1.9	.6	.65	.6	3.2
27	1.85	2.6	3.2	1.2	.9	3.5	1.9	2.1	.6	.8	.6	2.75
28	1.6	3.0	2.9	1.2	1.0	3.0	1.6	1.8	.6	.9	.6	2.4
29	1.5	.....	2.7	1.3	1.0	2.5	1.4	1.5	.55	.85	.6	2.2
30	1.6	.....	2.5	1.3	1.0	2.1	1.9	1.25	.55	.85	.6	2.3
31	1.5	.....	2.3	.....	1.1	.....	2.4	1.1	.....	.85	.....	2.3

NOTE.—Ice conditions at this station unknown with the exception of March 6, when backwater was reported.

Station rating table for Shenandoah River at Millville, W. Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	430	2.00	2,380	3.70	6,100	6.80	17,840
0.40	480	2.10	2,560	3.80	6,380	7.00	18,800
0.50	540	2.20	2,750	3.90	6,670	7.20	19,780
0.60	610	2.30	2,940	4.00	6,960	7.40	20,780
0.70	690	2.40	3,130	4.20	7,560	7.60	21,820
0.80	780	2.50	3,330	4.40	8,200	7.80	22,880
0.90	880	2.60	3,530	4.60	8,860	8.00	24,020
1.00	980	2.70	3,730	4.80	9,540	8.20	25,200
1.10	1,090	2.80	3,940	5.00	10,260	8.40	26,400
1.20	1,200	2.90	4,150	5.20	11,020	8.60	27,700
1.30	1,320	3.00	4,370	5.40	11,780	8.80	29,000
1.40	1,450	3.10	4,600	5.60	12,580	9.00	30,400
1.50	1,580	3.20	4,840	5.80	13,400	9.20	31,800
1.60	1,720	3.30	5,080	6.00	14,240	9.40	33,200
1.70	1,870	3.40	5,320	6.20	15,120	9.60	34,608
1.80	2,030	3.50	5,570	6.40	16,000	9.80	36,000
1.90	2,200	3.60	5,830	6.60	16,920	10.00	37,500

NOTE.—The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1895 and 1904-5. It is well defined between gage heights 0.4 foot and 5.2 feet. The table has been extended beyond these limits. Estimates above 5 feet are based on a discharge curve which is the product of a well-defined area curve and a fairly accurate extension of the velocity curve.

Estimated monthly discharge of Shenandoah River at Millville, W. Va., for 1905.

[Drainage area, 2,995 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,150	830	2,065	0.689	0.794
February	4,370	1,200	1,684	.562	.585
March	9,370	2,560	4,387	1.46	1.68
April	3,230	1,200	1,945	.649	.724
May	2,940	880	1,382	.461	.531
June	13,820	690	2,552	.852	.950
July	11,400	1,450	2,994	1.00	1.15
August	4,840	930	1,557	.520	.600
September	1,145	575	810	.270	.301
October	880	540	640	.214	.247
November	690	575	624	.208	.232
December	11,400	610	2,336	.780	.899
The year	13,820	540	1,915	.639	8.69

Discharge applied as for open channel during the ice season with the exception of March 6, which was corrected.

SOUTH BRANCH SHENANDOAH RIVER NEAR FRONT ROYAL, VA.

This station was established June 26, 1899, by A. P. Davis. It is located about 1 mile above the bridge, which is near the Norfolk and Western Railway station.

The channel is straight for 600 feet above and below the station and the current is sluggish. The railroad follows the right bank of the stream, and the railroad embankment, a few feet back from the river, is overflowed at extreme flood stages only. The left bank is low, liable to overflow, and is fringed with trees. The bed of the stream is composed of bed rock and is very uneven; in places the rock is overlain by silt, and this is liable to shift.

Discharge measurements are made from a cable, which has a span of 300 feet and is suspended over the branches of two large sycamore trees, with its right end fastened to the tree and its left anchored to the ground. The initial point for soundings is on the main cable 0.5 foot from the tree on the left bank.

The gage is a vertical timber spiked to a large sycamore tree on the left bank about 800 feet upstream from the cable. A high-water gage, reading from 14 to 26 feet, was established September 18, 1905. It is a vertical board spiked to the shore side of a large sycamore tree 325 feet upstream from the regular gage. The gage is read twice each day by Miss Brentie Johnson. Bench mark No. 1 is a headless spike on the river side of an elm tree on the left bank 8 feet downstream from the gage. It is 1.5 feet above the ground and has an elevation of 10.49 feet above the zero of the gage. Bench mark No. 2 is a nail driven horizontally into the downstream side of the stump of a large sycamore 270 feet downstream from the gage. It is 0.5 foot above the ground and is immediately below a blaze. Its elevation is 14.55 feet above the zero of the gage. Bench mark No. 3 is the top of a large, iron, staple ring, 3 feet above the ground, on the shore side of the tree to which the high-water gage is attached. Its elevation is 14.32 feet above the zero of the gage.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of South Branch Shenandoah River near Front Royal, Va., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 4	Robert Follansbee	860	1.40	4.78	1,203
May 16	do	1,068	1.56	5.28	1,663
September 18	R. H. Bolster	657	.80	3.95	527
October 27	Robert Follansbee	596	.77	3.84	459
December 26	do	1,274	1.87	5.94	2,357

Mean daily gage height, in feet, of South Branch Shenandoah River near Front Royal, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	4.15	.....	5.4	4.3	4.35	4.85	4.85	4.3	3.7	3.82	3.7
2	3.85	4.05	.....	5.4	4.2	4.25	4.7	4.7	4.38	3.7	3.7	3.8
3	3.95	4.0	.....	5.28	4.2	4.15	4.55	4.6	4.85	3.7	3.8	3.8
4	4.0	4.15	.....	5.2	4.0	4.3	4.5	4.5	4.65	3.6	3.78	3.75
5	4.0	4.35	6.15	4.75	4.2	4.25	6.25	4.4	4.5	3.6	3.75	3.8
6	4.0	4.25	5.85	5.15	4.15	4.2	5.7	4.4	4.4	3.6	3.8	3.82
7	4.6	4.2	5.4	5.3	4.2	4.1	5.35	4.35	4.35	3.55	3.75	3.88
8	5.15	4.3	5.05	5.15	4.1	4.1	5.05	4.25	4.3	3.6	3.7	4.25
9	5.2	4.3	5.5	5.1	4.05	4.0	4.95	4.2	4.15	3.6	3.72	4.18
10	4.6	4.5	6.65	5.1	4.0	4.0	4.8	4.1	4.0	3.6	3.72	4.05
11	4.45	4.45	8.25	5.0	4.05	4.0	4.65	4.1	3.9	3.6	3.7	4.0
12	4.85	4.4	7.4	4.8	4.15	4.0	5.15	4.0	3.88	3.65	3.8	4.12
13	4.85	4.35	6.9	4.9	4.0	4.0	6.2	4.25	3.8	3.6	3.72	4.05
14	5.1	4.4	6.52	4.8	5.45	3.9	7.45	4.4	3.9	3.7	3.7	3.95
15	5.55	4.45	6.15	4.8	5.2	3.9	6.8	5.25	4.0	3.72	3.6	4.05
16	5.2	4.35	6.0	4.7	5.28	3.8	7.6	6.2	3.95	3.8	3.65	4.15
17	5.05	4.35	5.85	4.7	5.55	3.8	6.45	6.28	3.9	3.7	3.58	4.15
18	4.9	4.4	5.8	4.6	5.55	3.8	5.7	5.65	3.9	3.7	3.65	4.25
19	4.9	4.3	5.8	4.5	5.2	3.8	5.25	5.1	3.9	3.75	3.7	4.12
20	4.45	4.3	5.75	4.4	4.45	4.2	5.0	4.78	3.9	3.75	3.7	4.0
21	4.32	4.4	5.95	4.35	4.65	5.25	4.85	4.45	3.9	3.72	3.75	5.5
22	4.22	4.4	7.0	4.3	4.45	4.95	4.6	4.3	3.8	3.72	3.68	8.32
23	4.28	4.75	7.6	4.3	4.4	5.05	5.8	4.25	3.82	3.6	3.68	8.0
24	4.1	4.95	6.9	4.3	4.35	6.2	6.9	4.2	3.82	3.5	3.62	6.75
25	3.95	5.7	6.75	4.42	4.3	9.35	6.55	4.15	3.75	3.60	3.6	6.4
26	4.15	6.45	5.55	4.4	4.25	7.3	6.35	4.1	3.7	3.65	3.65	5.95
27	4.15	8.0	6.35	4.5	4.2	6.1	6.2	4.1	3.7	3.78	3.7	5.55
28	4.1	.....	6.25	4.45	4.3	5.65	6.05	4.3	3.78	3.82	3.7	5.25
29	4.3	.....	5.95	4.3	4.15	5.25	5.5	4.4	3.8	3.8	3.65	5.25
30	4.25	.....	5.65	4.3	4.55	4.9	5.15	4.35	3.68	3.8	3.62	5.45
31	4.05	.....	5.55	.....	4.55	.....	5.0	4.3	.....	3.82	.....	5.85

NOTE.—Ice conditions during February and March. Gage washed out February 27 and replaced March 5.

Station rating table for South Branch Shenandoah River near Front Royal, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	320	4.50	890	5.60	2,070	6.60	3,600
3.50	350	4.60	970	5.70	2,210	6.70	3,770
3.60	385	4.70	1,060	5.80	2,350	6.80	3,940
3.70	425	4.80	1,150	5.90	2,490	6.90	4,120
3.80	465	4.90	1,250	6.00	2,640	7.00	4,300
3.90	510	5.00	1,350	6.10	2,790	7.20	4,680
4.00	560	5.10	1,460	6.20	2,940	7.40	5,080
4.10	610	5.20	1,570	6.30	3,100	7.60	5,480
4.20	670	5.30	1,690	6.40	3,260	7.80	5,900
4.30	740	5.40	1,810	6.50	3,430	8.00	6,320
4.40	810	5.50	1,940				

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904 and 1905. It is well defined between gage heights 3.4 feet and 5.3 feet. The table has been extended beyond these limits.

Estimated monthly discharge of South Branch Shenandoah River near Front Royal, Va., for 1905.

[Drainage area, 1,569 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,005	425	917	0.584	0.673
April	1,810	740	1,143	.728	.812
May	2,005	560	920	.586	.676
June	9,380	465	1,372	.874	.975
July	5,180	890	2,236	1.42	1.64
August	3,068	560	1,014	.646	.745
September	1,200	417	595	.379	.423
October	474	350	417	.266	.307
November	474	378	425	.271	.302
December	7,024	425	1,476	.941	1.08

NOTE.—Ice conditions during February and March; no estimates.

SOUTH RIVER AT BASIC, VA.

This station was established June 29, 1905, by N. C. Grover, in connection with the investigation of stream pollution in the Shenandoah Valley. It is located at the highway bridge one-half mile below the Chesapeake and Ohio Railway bridge at Basic, Va.

The channel is straight for 300 feet above and 500 feet below the station. The current is sluggish at ordinary stages. Both banks are subject to overflow, the right bank only during very high water. The bed of the stream is composed of rocks and mud and is liable to change after floods. The approximate depth of water is 3 to 4 feet at medium stage. Gage-height observations and measurements are affected by flour mills above the station, which cause rapid fluctuations in the gage height at times.

Discharge measurements are made from the upstream side of the single-span bridge to which the gage is fastened. The initial point for soundings is the face of the right abutment.

A standard chain gage is fastened to the upstream hand rail of the bridge. The length of the chain from the end of the weight to the outer edge of the ring is 20.84 feet. During 1905 the gage was read once each day by F. J. Bates. Bench mark No. 1 is the upstream corner of the lowest step of the wing wall of the bridge at the right bank, nearest the river. It is marked with red paint. Its elevation is 13.97 feet above the datum of the gage. Bench mark No. 2 is at the corner of the wing wall next above bench mark No. 1. Its elevation is 14.98 feet above the datum of the gage.

Discharge measurements of South River at Basic, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
June 11	N. C. Grover	70	136	.47	2.59	64
June 29	Follansbee and Biggi	70	156	.58	2.62	90
September 16	Bolster and Winter	70	146	0.43	2.52	63
December 29	Robert Follansbee	73	268	1.69	4.05	454

Mean daily gage height, in feet, of South River at Basic, Va., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.6	2.6	2.5	2.4	2.3	2.2
2	.....	2.5	2.7	2.5	2.3	2.1	2.3
3	.....	2.7	2.5	2.5	2.5	2.2	2.4
4	.....	2.6	2.5	2.5	2.3	2.1	2.9
5	.....	2.55	2.5	2.6	2.2	2.2	2.9
6	.....	2.6	2.5	2.3	2.2	2.3	2.8
7	.....	3.0	2.5	2.2	2.4	2.3	2.6
8	.....	2.8	2.5	2.3	2.4	2.3	2.5
9	.....	2.7	2.5	2.4	2.5	2.3	2.5
10	.....	3.0	2.6	2.5	2.4	2.3	2.5
11	.....	2.7	2.6	2.5	2.5	2.1	2.5
12	.....	4.25	2.6	2.5	2.7	2.3	2.6
13	.....	4.3	2.6	2.2	2.3	2.4	2.3
14	.....	5.0	2.7	2.2	2.2	2.3	2.4
15	.....	3.5	2.7	2.2	2.4	2.2	2.3
16	.....	3.2	2.9	2.2	2.4	2.1	2.3
17	.....	3.0	2.8	2.6	2.2	2.4	2.5
18	.....	2.9	2.7	3.2	2.6	2.2	2.5
19	.....	2.9	2.7	2.8	2.6	2.3	2.5
20	.....	2.8	2.7	2.7	2.4	2.3	2.5
21	.....	2.8	2.6	2.7	2.3	2.1	5.5
22	.....	2.7	2.6	2.6	2.4	2.3	4.1
23	.....	2.4	2.5	2.4	2.5	2.3	3.9
24	.....	2.5	2.5	2.5	2.4	2.3	3.7
25	.....	2.9	2.5	2.6	2.1	2.1	3.4
26	.....	2.8	2.8	2.5	2.4	2.3	3.2
27	.....	2.8	2.6	2.6	2.5	2.1	3.1
28	.....	2.7	2.5	2.6	2.3	2.0	2.9
29	2.5	2.8	2.5	2.4	2.4	2.2	3.7
30	2.5	2.7	2.3	2.4	2.4	2.3	3.3
31	.....	2.6	2.3	.....	2.6	.....	3.2

LEWIS CREEK NEAR STAUNTON, VA.

This station was established June 30, 1905, by N. C. Grover, in connection with the investigation of stream pollution in the Shenandoah Valley. It is located at the private bridge across Lewis Creek, on the property of William Glenn, 2 miles from Staunton.

The channel is straight for 300 feet above and below the station. The current is sluggish. Both banks are about 5 feet high and do not overflow, except during very high water. The bed of the stream is composed of soft mud. There is but one channel at all stages. The stream is composed almost wholly of sewage from the city of Staunton, and is very shallow at ordinary stages.

Discharge measurements are made from the downstream side of the bridge, the initial point for soundings being the gatepost near the left end of the bridge.

A vertical staff gage, graduated to feet and tenths, is fastened to a tree 6 feet downstream from the bridge. The gage is read once each day by Ashby Glenn. Bench mark No. 1 is a nail in the locust tree to which the gage is attached, 1 foot above the ground, on the upstream side. Its elevation is 7.59 feet above the zero of the gage. Bench mark No. 2 is a nail in a locust tree 50 feet upstream from the gage, 1 foot above the ground, on the downstream side. Its elevation is 7.01 feet above the zero of the gage. Bench mark No. 3 is the under side of the lowest timber course at the northeast corner of the house near the gage. Its elevation is 9.92 feet above the zero of the gage.

Discharge measurements of Lewis Creek near Staunton, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
June 30	Follansbee and Biggi	16	7.9	0.48	0.51	3.8
December 29	Robert Follansbee	16	10.1	.61	.60	6.2

Mean daily gage height, in feet, of Lewis Creek near Staunton, Va., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	0.65	0.45	0.5	0.4	0.4	0.5
2	.88	.55	.4	.4	.5	.5
3	.7	.45	.45	.65	.5	.6
4	.65	.45	.4	.4	.5	.4
5	.5	.6	.45	.4	.5	.5
6	.5	.5	.45	.35	.6	.5
7	.7	.5	.45	.4	.65	.45
8	.6	.45	.45	.4	.5	.5
9	.55	.5	.45	.6	.4	.5
10	.5	.45	.45	.5	.4	.4
11	.5	.35	.45	1.0	.55	.4
12	1.1	.45	.45	.8	.5	.4
13	.7	.45	.5	.7	.6	.45
14	.5	.45	.6	.5	.6	.5
15	.55	.5	.6	.4	.5	.6
16	.55	.5	.5	.4	.5	.65
17	.5	.45	.5	.5	.45	.5
18	.5	.6	.45	.45	.75	.5
19	.55	.5	.45	.45	.45	.5
20	.4	.45	.45	.6	.4	.45
21	.5	.45	.45	.6	.45	.4
22	1.05	.45	.5	.5	.55	.45
23	.6	.55	.45	.6	.35	.45
24	.6	.45	.45	.7	.35	.5
25	.55	.5	.45	.65	.5	.5
26	.5	.5	.4	.6	.5	.5
27	.6	.5	.4	.6	.5	.45
28	.45	.5	.4	.6	.45	.65
29	.5	.5	.4	.4	.4	.55
30	.45	.4	.4	.45	.4	.5
31	.5	.5	.....	.5	.....	.4

COOKS CREEK AT MOUNT CRAWFORD, VA.

This station was established July 1, 1905, by N. C. Grover, in connection with the investigation of stream pollution in the Shenandoah Valley. It is located at the upper highway bridge across Cooks Creek, three-fourths of a mile from Mount Crawford, Va.

The channel is straight for 200 feet above and 100 feet below the station. The current is very sluggish at low water. Both banks are low and liable to overflow during high water, but all the water passes beneath the bridge. The bed of the stream is composed of mud and gravel. The stream is polluted by tanneries.

Discharge measurements are made from the side of the bridge to which the gage is attached, or, preferably, by wading a short distance below, at a point where the velocity is greater.

A standard chain gage is fastened to the outside of the downstream guard rail of the bridge. The length of the chain from the end of the weight to the outer edge of the ring is 14.38 feet. During 1905 the gage was read once each day by S. H. Craun. Bench mark No. 1 is a nail driven vertically into a root on the downstream side of a large tree 150 feet below the gage, on the left bank. Its elevation is 4.24 feet above the gage datum. Bench mark No. 2 is a nail driven vertically into the top of a stump midway between the bridge and bench mark No. 1. Its elevation is 5.39 feet above the gage datum.

Discharge measurements of Cooks Creek at Mount Crawford, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
July 1	Follansbee and Biggi	30	78	0.26	2.10	20
December 30[a]	Robert Follansbee	24	18.6	1.21	2.08	22.6

[a] Made by wading below bridge.

Mean daily gage height, in feet, of Cooks Creek at Mount Crawford, Va., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.2	1.8	1.8	1.7	1.8
2	2.1	2.2	1.9	1.8	1.7	1.8
3	2.0	2.1	1.9	1.8	1.7	2.0
4	2.0	2.1	1.8	1.8	1.7	1.8
5	5.5	2.1	1.8	1.8	1.7	1.8
6	3.3	2.1	1.8	1.8	1.7	1.8
7	2.9	2.0	1.7	1.7	1.7	1.8
8	2.4	2.0	1.8	1.7	1.7	1.8
9	2.2	2.0	1.8	1.7	1.7	1.8
10	2.1	2.0	1.8	1.7	1.7	1.8
11	2.5	2.0	1.8	1.7	1.7	1.8
12	2.1	2.1	1.8	1.7	1.8	1.8
13	2.3	2.1	1.8	1.7	1.8	1.7
14	2.2	2.1	1.8	1.7	1.7	1.7
15	2.8	2.0	1.8	1.7	1.7	1.7
16	2.4	2.0	1.8	1.7	1.7	1.7
17	2.3	1.9	1.8	1.7	1.7	1.7
18	2.2	2.0	1.8	1.7	1.7	1.7
19	2.2	1.9	1.8	1.7	1.8	1.7
20	2.4	2.0	1.8	1.7	1.8	1.7
21	2.1	2.0	1.8	1.7	1.8	2.9
22	2.2	1.9	1.8	1.7	1.8	2.6
23	2.4	1.9	1.8	1.7	1.8	2.4
24	2.3	1.8	1.8	1.7	1.8	2.3
25	2.2	1.9	1.7	1.8	1.8	2.1
26	2.2	2.1	1.7	2.0	1.8	2.0
27	2.2	2.0	1.8	1.8	1.8	2.0
28	2.0	2.0	1.7	1.8	1.8	2.0
29	2.0	2.0	1.7	1.8	1.8	2.3
30	3.1	1.9	1.8	1.7	1.8	2.1
31	2.4	1.9	.....	1.7	.....	2.2

ELK RUN AT ELKTON, VA.

This station was established June 28, 1905, by N. C. Grover, in connection with the investigation of stream pollution in the Shenandoah Valley. It is located at the highway bridge, 500 feet south of the railroad station at Elkton, Va.

The channel is straight for 100 feet above and 200 feet below the station. The current is sluggish at the gage. Both banks are low and overflow during high water. All the water passes beneath the bridge, except during extreme floods. The bed of the stream is composed of gravel, and is permanent. The stream is highly polluted by tanneries along its banks.

Discharge measurements are made at ordinary stages at a foot bridge 1,000 feet downstream from the bridge, to which the gage is fastened. During high water discharge measurements are made from the highway bridge, to which the gage is attached.

A standard chain gage is fastened to a floor beam on the downstream side of the bridge, near the right end. The length of the chain from the end of the weight to the marker is 8.76 feet. During 1905 the gage was read once each day by C. L. Gooden. Bench mark No. 1 is a nail in a 12-inch tree, 5 feet upstream from the left end of the highway bridge, 1.5 feet above the ground, on the stream side. Its elevation is 6.01 feet above the datum of the gage. Bench mark No. 2 is the underside of the coping at the southwest corner of the first railway bridge pier on the right bank of the creek, marked with red paint "U.S.G.S.B.M." Its elevation is 11.96 feet above the datum of the gage. Bench mark No. 3 is a nail, 1 foot above the ground, in a telegraph pole 40 feet east of the left end of the foot bridge. Its elevation is 0.59 foot above the datum of the gage.

Discharge measurements of Elk Run at Elkton, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 22	N. C. Grover	13	4.7	1.04	.....	4.9
May 22	do	17	8.0	.50	.....	4.0
June 28	Follansbee and Biggi	34	20.4	.85	2.80	17.4
July 20	N. C. Grover	19	6.8	.50	2.10	3.4
December 28	Robert Follansbee	26	14.4	.76	2.78	11.0

Mean daily gage height, in feet, of Elk Run at Elkton, Va., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.7	2.6	2.6	2.5	2.7	2.7
2		2.7	2.55	2.5	2.5	2.7	2.7
3		2.6	2.55	2.5	2.5	2.7	2.7
4		2.6	2.5	2.5	2.45	2.7	2.7
5		2.6	2.5	2.6	2.45	2.7	2.7
6		2.6	2.5	2.5	2.5	2.7	2.7
7		2.6	2.5	2.4	2.5	2.7	2.7
8		2.6	2.65	2.4	2.5	2.8	2.65
9		2.5	2.6	2.4	2.6	2.7	2.65
10		2.55	2.5	2.4	2.6	2.7	2.7
11		2.55	2.7	2.45	3.2	2.7	2.7
12		3.5	2.7	2.4	2.9	2.7	2.65
13		3.1	3.2	2.45	2.7	2.7	2.65
14		2.9	3.9	2.45	2.6	2.8	2.65
15		2.7	3.0	2.45	2.6	2.7	2.6
16		2.6	2.8	2.4	2.6	2.7	2.6
17		2.6	2.7	2.4	2.7	2.7	2.6
18		2.6	2.6	2.4	2.65	2.7	2.6
19		2.55	2.65	2.4	2.65	2.7	2.7
20		2.5	2.6	2.9	2.65	2.75	3.3
21		2.55	2.6	2.6	2.7	2.7	3.5
22		2.7	2.65	2.5	2.7	2.65	2.8
23		2.5	2.6	2.5	2.7	2.65	2.7
24		2.5	3.1	2.5	2.7	2.65	2.7
25		2.5	3.2	2.5	2.8	2.65	2.8
26		2.5	3.0	2.5	2.8	2.65	2.7
27		2.5	3.0	2.5	2.7	2.65	2.8
28	2.75	2.6	2.8	2.5	2.7	2.65	2.8
29	2.8	2.6	2.7	2.5	2.7	2.65	3.0
30	2.65	2.6	2.7	2.5	2.7	2.65	2.95
31		2.6	2.6		2.7		2.9

HAWKSBILL CREEK NEAR LURAY, VA.

This station was established June 27, 1905, by N. C. Grover, in connection with the investigation of stream pollution in the Shenandoah River valley. It is located a short distance above the mouth of Dry Run, 1½ miles north of Luray, Va.

The channel is straight for 500 feet above and 200 feet below the station. The current is moderate above and swift below the station. Rapids below the gage prevent backwater influence from Dry Run, except in case of extreme floods. From well-defined marks the highest stage known was found to be 19.55 feet above the zero of the gage. This stage occurred October 13, 1893. The right bank is high, rocky, wooded, and does not overflow. The left bank is low and subject to overflow during high water. The bed of the stream is composed of gravel, is free from vegetation, and is permanent. There is but one channel at all stages. The approximate depth of the water at the bridge is 2 to 3 feet.

Discharge measurements are made from the footbridge in front of the observer's house. The initial point for soundings is the edge of rock at the right end of the bridge.

A staff gage in two sections, the lower one inclined and the upper vertical, graduated to feet and tenths, is fastened to the left bank 100 feet above the footbridge. During 1905 the gage was read once each day by J. S. Miller. Bench mark No. 1 is a small nail in the south side of an apple tree, half a foot above the ground, 45 feet west of the gage. Its elevation is 14.04 feet above the zero of the gage. Bench mark No. 2 is the top of the stone under the

vertical post on the upstream side of door frame in the old dairy building, 200 feet from the left end of the footbridge. Its elevation is 15.10 feet above the zero of the gage.

Discharge measurements of Hawksbill Creek near Luray, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
May 1	N. C. Grover	43	35.8	1.02	1.44	34.7
June 27	Follansbee and Biggl	45	46	1.38	1.74	64
December 28	Robert Follansbee	40	45	1.61	1.81	72

Mean daily gage height, in feet, of Hawksbill Creek near Luray, Va., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.6	1.45	1.4	1.35	1.4	1.4
2	.....	1.6	1.4	1.4	1.35	1.4	1.4
3	.....	1.6	1.4	1.4	1.4	1.4	1.65
4	.....	1.55	1.4	1.35	1.35	1.4	1.6
5	.....	1.55	1.4	1.3	1.35	1.4	1.5
6	.....	1.55	1.4	1.3	1.35	1.45	1.45
7	.....	1.55	1.4	1.3	1.35	1.45	1.45
8	.....	1.55	1.4	1.3	1.35	1.4	1.45
9	.....	1.5	1.4	1.3	1.35	1.4	1.45
10	.....	1.5	1.4	1.4	1.35	1.4	1.45
11	.....	1.5	1.4	1.4	1.45	1.4	1.45
12	.....	1.5	1.4	1.4	1.45	1.4	1.45
13	.....	1.5	1.4	1.35	1.4	1.4	1.45
14	.....	1.5	1.4	1.3	1.4	1.4	1.45
15	.....	1.45	1.35	1.3	1.4	1.4	1.45
16	.....	1.4	1.35	1.3	1.35	1.4	1.45
17	.....	1.4	1.35	1.35	1.35	1.4	1.4
18	.....	1.4	1.45	1.5	1.35	1.4	1.4
19	.....	1.4	1.45	1.35	1.35	1.4	1.5
20	.....	1.4	1.45	1.35	1.35	1.4	1.5
21	.....	1.4	1.45	1.35	1.35	1.4	2.9
22	.....	1.4	1.45	1.35	1.35	1.4	2.75
23	.....	1.45	1.45	1.35	1.35	1.4	2.65
24	.....	1.45	1.75	1.4	1.4	1.35	2.5
25	.....	1.45	1.5	1.4	1.5	1.35	2.35
26	.....	1.4	1.65	1.4	1.6	1.35	2.2
27	1.75	1.4	1.4	1.4	1.5	1.35	2.0
28	1.7	1.4	1.4	1.35	1.45	1.4	1.85
29	1.65	1.4	1.4	1.35	1.45	1.45	1.75
30	1.6	1.6	1.4	1.35	1.45	1.4	2.4
31	.....	1.5	1.4	.....	1.4	.....	2.25

NORTH BRANCH SHENANDOAH RIVER NEAR RIVERTON, VA.

This station was established June 26, 1899, by A. P. Davis. It is located about 2 miles above Riverton, Va., on the farm owned by L. W. Burke. It is most easily reached by driving from Front Royal, Va.

The channel is straight for 600 feet above and below the station. The current has a moderate velocity. Both banks are low and liable to overflow, and are fringed with trees. The bed of the stream is composed of rock and mud and shifts somewhat, but the flow is controlled by the dam at Riverton, 2 miles below. The height of the dam was increased from 8 feet to 10 feet during August, 1904. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, and tagged wire just above the ford. The cable has a span of 260 feet, is supported by timbers, and is anchored in the ground at each end. The initial point for soundings is 0.5 foot from the timber which supports the tag wire on the left bank.

The original gage was a vertical timber bolted to a large sycamore tree on right bank. On September 10, 1900, the gage was removed to the left bank and its datum was lowered 1 foot, causing all readings to be increased by 1 foot. The gage at this station was washed out in the flood of February 22, 1902, and the station was abandoned until August 17, 1902, when it was reestablished, the zero of the new gage being at the same elevation as the zero of the former gage. The vertical gage rod is spiked to timber and to a sycamore tree on the left bank about 100 feet above the cable station. The gage is read twice each day by L. W. Burke. Bench mark No. 1 is a wire nail driven into a pear tree. This tree is located near a fence and is 150 feet from the left bank of the river. Its elevation above the zero of the gage is 26.75 feet. Bench mark No. 2 is formed by three wire nails driven flush in the surface of a stump 50 feet downstream from the fence line of the road, at the edge of the field on the side toward the river. Its elevation is 20.44 feet above the zero of the gage.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of North Branch Shenandoah River near Riverton, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 3	Robert Follansbee	235	516	1.25	5.18	645
May 17	do	235	648	1.53	5.68	989
October 27	do	235	377	.72	4.48	273
December 27	do	235	626	1.53	5.60	961

Mean daily gage height, in feet, of North Branch Shenandoah River near Riverton, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.28	5.5	5.5	5.45	4.6	4.6	5.3	5.05	4.4	4.2	4.35	4.22
2	4.2	5.5	5.5	5.3	4.7	5.05	5.45	4.8	4.4	4.2	4.4	4.15
3	4.35	5.5	5.5	5.2	4.6	4.85	5.25	4.65	4.35	4.15	4.3	4.45
4	5.55	5.5	5.5	5.15	4.6	4.68	5.05	4.6	4.3	4.25	4.3	4.7
5	5.90	5.5	.....	5.15	4.52	4.55	5.3	4.6	4.38	4.2	4.38	5.05
6	5.90	5.5	5.8	5.60	4.6	4.5	6.9	4.48	4.45	4.15	4.35	4.9
7	5.90	5.5	5.75	5.80	4.6	4.9	5.75	4.4	4.4	4.15	4.35	4.75
8	.....	5.5	6.0	5.65	4.52	4.95	5.5	4.35	4.4	4.15	4.3	4.7
9	.....	5.5	6.4	5.5	4.55	4.7	5.7	4.38	4.35	4.15	4.22	4.55
10	.....	5.5	7.65	5.4	4.5	4.5	5.3	4.4	4.3	4.05	4.32	4.5
11	.....	5.5	7.45	5.25	4.5	4.42	5.35	4.4	4.28	4.25	4.38	4.42
12	.....	5.5	6.75	5.3	4.5	4.25	6.15	4.4	4.3	4.35	4.32	4.42
13	.....	5.5	6.4	5.25	4.5	4.65	5.75	4.32	4.3	4.25	4.28	4.42
14	.....	5.5	5.95	5.15	4.55	4.4	6.9	5.1	4.3	4.2	4.15	4.48
15	.....	5.5	5.75	5.1	5.45	4.4	7.1	4.7	4.28	4.2	4.22	4.38
16	.....	5.5	5.6	5.05	6.15	4.3	6.1	5.48	4.32	4.25	4.2	4.4
17	.....	5.5	5.5	4.98	5.65	4.2	5.5	5.45	4.32	4.25	4.18	4.55
18	.....	5.5	5.4	4.92	5.35	4.2	5.2	5.0	4.4	4.25	4.1	4.7
19	.....	5.5	5.4	4.9	5.2	4.25	5.05	4.8	4.32	4.2	4.18	4.62
20	.....	5.5	5.4	4.9	4.55	4.2	4.92	4.7	4.32	4.25	4.2	4.6
21	.....	5.5	5.95	4.8	4.92	6.2	4.8	4.6	4.28	4.2	4.15	7.3
22	.....	5.5	6.4	4.8	4.8	6.95	4.8	4.4	4.25	4.2	4.18	9.55
23	4.75	5.5	6.5	4.75	4.7	7.5	5.55	4.4	4.3	4.15	4.2	7.75
24	5.5	5.5	6.05	4.7	4.62	10.75	5.95	4.35	4.2	4.1	4.2	6.95
25	5.5	5.5	7.45	4.7	4.6	9.05	5.4	5.0	4.2	4.2	4.22	6.5
26	5.5	5.5	6.95	4.7	4.55	7.0	5.15	6.1	4.15	4.5	4.22	5.95
27	5.5	5.5	6.5	4.7	4.4	6.2	4.92	5.45	4.2	4.48	4.18	5.55
28	5.5	5.5	6.2	4.8	4.5	6.2	4.78	4.9	4.2	4.35	4.12	5.4
29	5.5	.....	5.9	4.8	4.42	5.7	4.75	4.75	4.2	4.3	4.2	5.7
30	5.5	.....	5.7	4.7	4.4	5.4	5.6	4.6	4.2	4.32	4.2	6.28
31	5.5	.....	5.55	.....	4.45	.....	5.7	4.5	.....	4.42	.....	6.0

NOTE.- River frozen over January 5 to March 4; gage read to water surface in hole in ice. January 8-22, gage displaced by ice.

Station rating table for North Branch, Shenandoah River, near Riverton, Va., from August 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	100	5.10	595	6.10	1,320	7.10	2,270
4.10	125	5.20	655	6.20	1,405	7.20	2,380
4.20	155	5.30	720	6.30	1,495	7.30	2,490
4.30	190	5.40	785	6.40	1,585	7.40	2,600
4.40	230	5.50	855	6.50	1,680	7.50	2,720
4.50	275	5.60	925	6.60	1,775	7.60	2,840
4.60	325	5.70	1,000	6.70	1,870	7.70	2,960
4.70	375	5.80	1,075	6.80	1,970	7.80	3,080
4.80	425	5.90	1,155	6.90	2,070	7.90	3,210
4.90	480	6.00	1,235	7.00	2,170	8.00	3,340
5.00	535						

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and 1905 after dam at Riverton was raised 2 feet. It is well defined between gage heights 4 feet and 5.5 feet. The table has been extended beyond these limits. During August, 1904, the dam was raised 2 feet. The exact date is uncertain, but the table is assumed to apply from August 16, 1904.

Estimated monthly discharge of North Branch Shenandoah River near Riverton, Va., for 1905.

[Drainage area, 1,037 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March (6-31)[a]	2,900	785	1,424	1.37	1.32
April	1,075	375	596	.575	.642
May	1,362	230	406	.392	.452
June	7,450	155	1,042	1.00	1.12
July	2,270	400	908	.876	1.01
August	1,320	198	417	.402	.464
September	252	140	192	.185	.206
October	275	112	170	.164	.189
November	230	125	172	.166	.185
December	5,575	140	889	.857	.988

[a] Ice conditions January 1-March 4; no estimates.

PASSAGE CREEK AT BUCKTON, VA.

This station was established October 26, 1905, by Robert Follansbee. It is located about 700 feet above the mouth of the creek, at the trestle of the Southern Railway at Buckton, which is a siding 1 mile east of Waterlick, Va. Passage Creek is a tributary of Shenandoah River.

The channel is straight for 200 feet above and 100 feet below the station. The current is moderate at the measuring section, but from 100 feet below the section to the mouth of the creek the velocity is quite rapid, the fall in that distance being from 6 to 8 feet. The banks above the bridge are fairly high, wooded, and not liable to overflow. Below the bridge they are low and liable to overflow during very high water, the flood plain being several hundred feet wide at such times. The channel between abutments is broken by seven trestle bents, and there are from three to eight channels, according to the stage of the river.

Discharge measurements at ordinary and low stages are made from the railway trestle, or preferably by wading a short distance above, at a point where conditions are better. High-water measurements can be made from the highway bridge 2 miles upstream. This latter is not a good section at ordinary stages, as the current is too sluggish.

A staff gage, which is read once each day and oftener in flood by Nehemiah Messick, is nailed vertically to the third trestle bent from the left abutment. No bench mark has been established, but two nails are driven into the trestle bent at an approximate elevation of 5.63 feet above the gage zero.

Discharge measurements of Passage Creek at Buckton, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
October 26	Robert Follansbee	47	50	0.80	1.23	40.5
December 27	do	47	51	.98	1.25	50.0

Mean daily gage height, in feet, of Passage Creek at Buckton, Va., for 1905.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	0.95	0.9	12	.....	0.85	0.9	22	.....	.9	3.1
2	.....	.9	.9	13	.....	.9	.95	23	.....	0.9	2.35
3	.....	.95	.95	14	.....	.85	.9	24	.....	.85	2.0
4	.....	.9	1.4	15	.....	.9	.95	25	.....	.9	1.95
5	.....	.95	1.2	16	.....	.95	1.15	26	1.20	.9	1.45
6	.....	.95	1.2	17	.....	.85	1.1	27	1.15	.85	1.4
7	.....	.9	1.1	18	.....	.9	1.15	28	1.15	.9	1.25
8	.....	.95	1.15	19	.....	.85	1.1	29	.9	.85	2.2
9	.....	.9	.95	20	.....	.95	1.15	30	.95	.95	1.8
10	.....	.95	.95	21	.....	.9	3.15	31	.95	.....	1.4
11	.....	.95	.95								

NOTE.—Creek frozen December 17-19, inclusive.

MONOCACY RIVER NEAR FREDERICK, MD.

This station was established August 4, 1896, by E. G. Paul. It is located at the county bridge on the toll road leading from Frederick to Mount Pleasant, Md. It is 4 miles northeast of Frederick, about 2,000 feet above the mouth of Israel Creek, and 3,000 feet below the mouth of Tuscarora Creek.

The channel is straight for 300 feet above and 100 feet below the bridge. Both banks are low, liable to overflow, and covered with a fringe of trees, but all water passes beneath the bridge. The bed is composed of gravel and cobblestones, except near the banks, where it is composed of silt and is subject to change.

Discharge measurements are made from the 2-span highway bridge, which has a total span of 310 feet. The channel at this point is divided by a small, low island, which serves as a foundation for the pier of the bridge. The right channel is measured from the lower and the left from the upper side of the bridge, as the results are better than would be furnished by a continuous section on either side of the bridge. The pier and island obstruct the flow to some extent, causing dead water for 20 feet to the right of the pier at low water and eddies at high water. The initial point for soundings is a cross cut in the face of the parapet wall on the lower wing of the right abutment.

The original wire gage has been replaced by a standard chain gage, which is located in the middle of the first span from the right bank and is attached to the bridge floor on the lower side of the bridge. The length of the chain from the end of the weight to the marker is 35.04 feet. The gage is read twice each day by E. L. Derr. The bench mark is a hole drilled in the top of a coping stone on the lower wing of the right abutment, about 100 feet back from the initial point for soundings. Its elevation is 29.17 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 34; 19, iv, p 153; 20, iv, p 129; WS 15, p 20; 27, p 10; 35, pp 93-94; 48, p 125; 65, p 234; 82, pp 181-182; 97, pp 305-306; 126, pp 76-77.

Discharge: Ann 18, iv, p 34; 19, iv, p 153; WS 15, p 20; 27, p 24; 35, p 94; 48, p 125; 65, p 234; 82, p 182; 97, p 306; 126, p 77.

Discharge, monthly: Ann 18, iv, p 35; 19, iv, p 154; 20, iv, pp 120, 129; 21, iv, p 98; 22, iv, p 139; WS 75, p 40; 82, p 183; 97, p 308; 126, p 79.

Discharge, yearly: Ann 20, iv, p 49.

Gage heights: WS 11, p 11; 15, p 20; 27, p 21; 35, p 94; 48, p 125; 65, p 235; 82, p 182; 97, p 307; 126, pp 77-78.

Hydrographs: Ann 19, iv, p 155; 20, iv, p 130; 21, iv, p 98; 22, iv, p 140.

Rating tables: Ann 18, iv, p 35; 19, iv, p 154; WS 27, p 25; 39, p 442; 52, p 512; 65, p 319; 82, p 183; 97, p 307; 126, p 78.

Water powers and pollution: Ann 19, iv, p 153.

Discharge measurements of Monocacy River near Frederick, Md., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 11	Tillinghast and Comstock	287	1,590	2.93	10.13	4,441
March 11	do	287	1,503	2.53	9.88	3,800
October 31	G. F. Harley	159	298	1.07	4.68	319
June 21	Grover and Lyman	155	217	.78	4.16	170

Mean daily gage height, in feet, of Monocacy River near Frederick, Md., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	5.0	8.1	5.9	4.9	7.5	4.5	4.2	3.8	4.0	4.0	4.0
2	4.9	4.9	7.5	7.2	4.8	6.4	4.3	4.9	3.8	4.0	4.0	4.0
3	4.8	5.4	6.2	6.4	4.7	6.0	4.3	4.7	3.8	3.8	4.0	4.0
4	5.5	4.9	6.2	5.5	4.8	5.3	4.2	4.5	3.8	3.8	4.0	4.0
5	5.1	4.6	5.9	5.4	4.7	7.4	4.2	4.3	3.8	3.8	4.0	4.0
6	4.9	4.7	6.0	5.5	4.8	7.0	4.2	4.0	3.9	3.8	4.0	4.0
7	4.7	8.2	17.0	5.4	4.7	6.8	4.4	4.0	3.9	3.8	4.0	4.0
8	4.6	14.15	17.2	5.6	5.0	5.7	6.2	4.2	3.9	3.8	4.0	4.0
9	4.6	6.4	8.2	7.8	4.9	5.4	7.1	4.5	3.9	3.8	4.0	4.0
10	4.6	6.1	6.5	7.2	5.7	5.2	8.2	4.5	4.9	3.8	4.2	4.2
11	4.6	6.0	6.6	6.4	5.4	5.4	7.3	12.6	5.2	3.8	4.0	4.2
12	4.6	5.4	7.0	5.9	4.8	5.1	6.1	5.6	4.9	3.8	4.0	4.2
13	4.6	5.1	6.2	5.6	4.7	5.0	7.4	4.6	4.8	6.0	4.2	4.2
14	4.6	4.9	5.9	5.4	4.8	4.7	6.4	4.2	4.8	5.4	4.4	4.2
15	4.6	4.9	5.8	5.1	5.0	4.6	5.2	4.2	4.7	4.8	4.4	4.2
16	4.6	5.0	5.6	5.2	5.0	4.6	4.2	4.1	4.7	4.0	4.2	4.2
17	4.5	4.9	5.5	5.0	4.8	4.5	4.1	4.1	4.6	4.0	4.2	4.2
18	4.5	4.9	5.6	4.9	4.9	4.6	4.1	4.0	4.6	3.8	4.2	4.2
19	4.5	4.9	5.5	4.9	5.2	4.5	4.1	4.0	4.6	3.8	4.2	4.2
20	4.5	4.9	5.8	4.8	5.2	9.8	4.0	4.2	5.6	3.8	4.2	4.2
21	4.5	5.0	6.2	4.8	4.9	7.4	4.0	4.7	5.2	4.0	4.0	4.2
22	4.5	13.75	6.5	4.6	4.8	5.9	4.0	4.7	4.9	5.0	4.0	4.2
23	19.9	12.2	6.8	4.6	4.6	4.9	4.0	4.6	4.6	4.6	4.0	4.2
24	11.5	9.0	6.2	4.7	4.6	4.5	5.1	4.5	4.4	4.4	4.0	4.4
25	6.1	6.8	5.9	4.6	4.4	4.4	5.1	4.2	3.9	4.2	4.0	4.6
26	5.9	5.2	5.7	4.8	4.5	4.3	5.1	4.2	4.0	4.0	4.0	5.4
27	4.6	4.9	5.7	4.9	4.4	4.1	5.1	4.1	4.2	4.0	4.0	6.8
28	4.6	4.8	5.4	5.3	4.5	4.2	5.0	3.9	4.4	4.0	4.0	9.4
29	5.5	4.8	5.2	5.3	4.3	4.2	4.9	3.8	4.2	4.0	4.0	9.2
30	6.1	.....	5.2	5.1	4.4	4.3	4.4	3.8	4.0	4.0	4.0	7.8
31	5.9	.....	5.4	.....	4.5	.....	4.2	3.8	.....	4.0	.....	5.8

NOTE.—River frozen at the gage January 4–22; also February 15–22. These gage heights have been revised since being published in the 1904 Progress Report, owing to an error in datum during the latter part of the year.

Mean daily gage height, in feet, of Monocacy River near Frederick, Md., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.0	5.2	5.8	6.0	4.8	4.6	4.5	5.7	5.0	4.2	4.7	8.1
2	6.4	5.0	5.8	5.8	4.8	4.4	5.2	5.1	4.9	4.1	4.7	7.2
3	6.8	5.0	5.4	5.6	4.8	4.4	4.9	4.9	7.5	4.2	4.7	9.5
4	6.4	4.8	5.2	5.4	4.6	4.4	4.6	4.7	6.4	5.0	4.6	9.2
5	6.2	4.8	6.6	6.4	4.6	4.2	4.5	4.6	6.1	4.5	4.6	8.3
6	6.2	4.8	6.8	6.4	4.6	4.2	8.0	4.5	5.9	4.3	4.6	6.1
7	17.4	4.8	7.4	6.2	4.6	4.6	7.9	4.4	5.1	4.4	4.6	5.6
8	9.8	4.8	7.4	5.8	4.6	7.4	7.6	4.5	5.1	4.2	4.5	5.5
9	7.2	4.8	10.9	5.6	4.6	7.2	6.5	4.5	4.9	4.3	4.5	5.4
10	6.8	4.8	14.6	5.4	4.6	5.6	5.6	4.5	4.8	4.3	4.4	5.3
11	6.6	4.8	11.8	7.6	4.4	4.4	4.9	4.5	4.9	4.4	4.4	5.1
12	6.4	4.8	9.8	6.8	4.4	4.9	4.9	4.5	7.2	6.7	4.4	5.0
13	6.4	4.8	9.0	6.4	4.4	8.3	4.9	5.8	5.5	6.1	4.4	5.0
14	6.2	4.8	8.8	6.0	4.8	6.0	6.1	6.1	5.1	5.9	4.4	5.0
15	5.8	4.8	8.2	5.8	5.0	5.2	10.6	5.5	4.9	5.3	4.3	4.9
16	5.8	4.8	8.2	5.6	4.8	4.8	7.9	5.4	4.6	4.9	4.3	4.9
17	6.0	4.8	9.0	5.4	4.8	4.6	5.9	5.3	4.7	4.4	4.3	5.0
18	6.2	4.8	9.2	5.4	4.8	4.4	4.9	4.6	5.1	4.4	4.3	5.0
19	6.4	4.8	8.6	5.2	4.8	4.4	4.6	4.4	5.2	4.9	4.3	5.0
20	6.4	4.8	9.4	5.2	4.6	4.4	4.6	4.5	5.1	7.4	4.3	5.75
21	5.8	4.8	14.8	5.2	4.6	4.1	4.6	4.5	4.9	7.0	4.3	18.65
22	5.6	4.8	10.4	5.0	4.6	4.3	4.6	4.5	4.6	6.9	4.2	12.6
23	5.4	4.8	8.8	5.0	4.4	6.3	5.9	4.4	4.6	6.1	4.3	10.5
24	5.2	4.8	8.2	5.0	4.4	7.4	12.1	4.4	4.5	5.1	4.3	7.5
25	5.4	4.8	8.0	4.8	4.2	7.5	7.9	16.0	4.4	4.7	4.3	6.9
26	6.2	5.0	8.0	4.8	4.2	6.9	6.9	18.8	4.4	5.6	4.3	6.5
27	5.8	5.6	7.6	4.8	4.2	6.5	5.1	12.5	4.3	5.7	4.3	5.9
28	5.6	5.6	6.8	5.8	4.2	5.1	4.9	6.4	4.2	5.3	4.3	5.7
29	5.6	.....	6.4	5.2	4.2	4.9	4.8	5.7	4.2	4.8	7.4	10.65
30	5.6	.....	6.4	5.0	4.2	4.6	7.6	5.4	4.2	4.8	8.5	8.7
31	5.6	.....	6.2	.....	4.2	.....	6.9	5.3	.....	4.7	.....	6.7

NOTE.—From January 27 to February 28 the river was frozen entirely across except for a narrow channel in the middle. Gage heights are to the surface of the water in a hole in the ice. Thickness of ice 1 foot.

Station rating table for Monocacy River, near Frederick, Md., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.80	80	5.00	450	6.20	1,102	7.80	2,400
3.90	99	5.10	493	6.30	1,172	8.00	2,580
4.00	120	5.20	538	6.40	1,242	8.20	2,765
4.10	144	5.30	584	6.50	1,315	8.40	2,955
4.20	170	5.40	632	6.60	1,390	8.60	3,145
4.30	198	5.50	682	6.70	1,465	8.80	3,335
4.40	228	5.60	734	6.80	1,545	9.00	3,525
4.50	260	5.70	789	6.90	1,625	9.20	3,715
4.60	294	5.80	846	7.00	1,705	9.40	3,905
4.70	330	5.90	906	7.20	1,875	9.60	4,100
4.80	368	6.00	969	7.40	2,045	9.80	4,300
4.90	408	6.10	1,034	7.60	2,220	10.00	4,500

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900 to 1905. It is fairly well defined between gage heights 4 feet and 10 feet. The table has been extended beyond these limits. Above 10 feet the discharge is approximate.

Estimated monthly discharge of Monocacy River near Frederick, Md., for 1904–5.

[Drainage area, 665 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
January (1–3; 23–31)[a]	14,090	294	2,192	3.30	1.47
February (1–14; 23–29)[a]	8,758	294	1,537	2.31	1.80
March	11,120	538	1,758	2.64	3.04
April	2,400	294	729	1.10	1.23
May	789	198	375	.561	.647
June	4,300	144	817	1.23	1.37
July	2,765	120	586	.881	1.02
August	7,130	80	436	.656	.756
September	734	80	251	.377	.421
October	969	80	209	.314	.362
November	228	120	138	.208	.232
December	3,905	120	549	.826	.952
1905.					
January (1–26)[b]	11,340	538	1,614	2.43	2.35
March	9,440	538	3,056	4.60	5.30
April	2,220	368	790	1.19	1.33
May	450	170	279	.420	.484
June	2,860	144	748	1.12	1.25
July	6,605	260	1,296	1.95	2.25
August	12,880	228	1,374	2.07	2.39
September	2,130	170	546	.821	.916
October	2,045	144	583	.877	1.01
November	3,050	198	390	.586	.654
December	12,720	408	2,099	3.16	3.64

[a] River frozen January 4–22 and February 15–22; no estimates made.
[b] Ice conditions January 27 to February 28; no estimates made.

JAMES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The headwaters of the James lie in the high mountains in the extreme western part of Virginia. The river is formed by the confluence of Jackson and Cowpasture rivers in the northern part of Botetourt County, Va.; thence it flows eastward across the State and empties into Chesapeake Bay through Hampton Roads. The total length of the river is about 335 miles and its drainage area is about 9,700 square miles. The river and all its tributaries lie wholly within the State of Virginia.

The topography of the basin is varied in character, changing from the mountainous section in the upper part to low, flat, and often swampy areas as tide water is approached. Jackson and Cowpasture rivers flow in narrow valleys between steep hills, over beds of sand and gravel, with rock ledges in places, and are bordered with fertile bottom lands. In this portion of the basin the water collects quickly, causing rapid rises in the river below.

Near Clifton Forge and again near Balcony Falls the James flows through ridges of the Alleghenies, with sharp falls over beds of solid rock. At other points similar though less pronounced falls and rapids occur as the river cuts through the lesser foothills. Between these mountainous or hilly sections the stream winds through broad and fertile valleys over beds of sand and gravel, with gentle slope. The fall line is crossed at Richmond.

Many dams have been built in the James, generally for diverting water into the old James and Kanawha Canal, which followed the river from Richmond to Buchanan and was at one time utilized throughout that entire distance. It has now been abandoned, however, and its right of way is owned and for considerable distances occupied by the Chesapeake and Ohio Railway. The use of the dams was abandoned with the canal, and though many of them are in good repair they have not been improved for power purposes. The principal utilized power is at Richmond. On October 19, 1904, a measurement of the James and Kanawha Canal was made about 5 miles above Richmond, Va., at a bridge opposite the 5-mile post of the Chesapeake and Ohio Railroad. Area, 318 square feet; mean velocity, 1.75 feet per second; discharge, 556 second-feet.

The fluctuations in stage are great. The record of the Cartersville station, which extends over a period of seven years, shows a range in gage height of nearly 25 feet. The estimated discharge has varied between 97,800 and 600 second-feet.

In 1897 a reconnaissance survey of James River was made under the direction of D. C. Humphreys, professor of civil engineering of Washington and Lee University. This survey covered the portion of the river between Clifton Forge and Richmond and a part of North River and consisted in determining the profile, which was done by using the profile of the Chesapeake and Ohio Railway as a base, and tying on to the water surface at each dam and at intermediate points not more than 5 miles apart. Notes were made in regard to the condition of the dams and measurements of flow were made on all of the more important tributaries. The results of this reconnaissance were published in the Nineteenth Annual Report of the United States Geological Survey, Part IV, pages 162–173.

Gages were established on James River in 1893 by F. B. Isaacs, engineer for water power of the Chesapeake and Ohio Railway Company, at Ninemile Locks, Columbia, Scottsville, Lynchburg, Balcony Falls, Buchanan, Eagle Mountain, and Clifton Forge. Records of heights of water at these points were made twice daily from 1893 to 1897 and freshet reports were obtained for these years. The gages were not referred to any fixed datum, but the zero of each gage was set at what was considered ordinary low water in the river. During the latter part of 1899 records were resumed, except at Scottsville, Balcony Falls, and Eagle Mountain, where the gages have been abandoned.

At Boshers dam, 9 miles above Richmond, is a gage where the height of water is recorded twice daily, showing the supposed head on the crest of the dam. The crest, however, is so irregular that the coefficient of discharge has not been ascertained. Another complication exists in the fact that water is deflected into a canal, the quantity not being known.

The United States Weather Bureau maintains river stations on the James at Lynchburg, Columbia, and Richmond, Va.

During 1905 the United States Geological Survey has maintained gaging stations in this basin as follows:

James River at Buchanan, Holcomb Rock, and Cartersville, Va.
North (of James) River near Glasgow, Va.
Appomattox River at Mattoax, Va.

JAMES RIVER AT BUCHANAN, VA.

This station was established August 18, 1895, by C. C. Babb. It is located at the iron highway bridge near the Chesapeake and Ohio Railway station and one-half mile from the Norfolk and Western Railway station. It is about 20 miles from the mouth of North River and one-half mile above the mouth of Purgatory Creek. The United States Weather Bureau maintained a gage at this point for about two years before measurements were made by the Geological Survey.

The channel is straight for 800 feet above and for about the same distance below the station. The current has moderate velocity and is broken by the pier of the bridge. Both banks are high, not liable to overflow, and without trees. The bed of the stream is rock and mud and shifts somewhat, but the flow at the measuring section is determined by a permanent rock control a few hundred yards downstream.

Discharge measurements are made from the lower side of the two-span, iron, highway bridge, which has a total span of 350 feet. The initial point for soundings is the end pin on the lower side of the bridge at the left bank.

On April 23, 1897, the datum of the original wire gage was lowered 2 feet to avoid negative readings. On November 21, 1903, the wire gage was replaced by a standard chain gage. It is located on the upstream side of the bridge near the center of the left span. The length of the chain from the end of the weight to the marker is 35.08 feet. The gage is read twice each day by U. H. Hyde. Bench mark No. 1 is the top of the stone post under the southwest corner of the porch of the Chesapeake and Ohio Railway station. Its elevation is 24.68 feet above gage datum. Bench mark No. 2 is a copper bolt in a ledge of rock on the left bank, 500 feet above the station. Its elevation is 16.23 feet above gage datum. This bench mark was established November 21, 1903, at which time the old bench mark on this ledge could not be found. Bench mark No. 3 is a United States Geological Survey aluminum tablet set in the upstream side of the left abutment. Its elevation is 29.22 feet above gage datum. Bench mark No. 4 is the top of the upper end of the seventh floor beam from the left bank. Its elevation is 30.03 feet above gage datum.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of James River at Buchanan, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 20	A. H. Horton	328	1,565	2.32	4.29	3,631
May 23	N. C. Grover	322	1,296	1.60	3.46	2,079
May 24	do	322	1,232	1.53	3.33	1,889
September 12	M. W. Winter	315	920	.62	2.17	573

Mean daily gage height, in feet, of James River at Buchanan, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.19	2.17	3.6	3.36	2.45	3.64	2.81	3.04	2.14	1.88	2.1	2.05
2	2.17	2.09	4.38	3.25	2.45	3.34	2.85	2.84	2.47	1.91	2.06	2.05
3	2.17	2.02	4.59	3.09	2.42	3.13	3.05	2.71	3.55	1.98	2.02	3.06
4	2.14	1.98	4.32	3.05	2.38	2.84	2.88	2.91	3.33	1.95	2.0	5.9
5	2.14	1.98	5.1	3.05	2.38	2.7	3.22	2.64	3.02	1.95	2.0	4.35
6	2.28	2.01	5.0	3.41	2.44	2.67	3.22	2.87	2.7	1.92	2.0	3.86
7	2.69	2.06	4.76	4.42	2.58	2.58	5.0	2.8	2.48	1.9	2.0	3.18
8	2.81	2.08	5.48	4.08	2.74	2.52	5.08	2.7	2.33	1.88	2.0	2.86
9	2.55	2.08	6.01	3.91	2.8	2.47	4.48	2.64	2.27	1.88	2.0	2.75
10	2.43	2.1	11.22	3.71	2.8	2.38	3.83	2.58	2.24	1.85	2.0	2.65
11	2.39	2.14	8.49	3.56	2.78	2.34	3.48	2.55	2.22	2.09	2.0	2.55
12	2.64	2.24	6.66	3.51	7.62	2.33	5.03	2.55	2.2	2.21	2.0	2.44
13	4.57	2.34	5.83	3.38	9.25	2.3	14.82	2.55	2.21	2.19	2.0	2.4
14	5.11	2.52	5.32	3.28	6.54	2.28	11.39	2.55	2.22	2.14	2.0	2.4
15	3.73	2.67	4.9	3.2	6.49	2.26	8.45	2.78	2.19	2.1	2.0	2.32
16	3.17	2.46	4.56	3.03	8.28	2.23	6.17	3.13	2.13	2.05	2.0	2.36
17	2.83	2.31	4.3	3.49	7.2	2.23	5.19	3.0	2.1	2.05	2.0	2.39
18	2.97	2.28	4.36	2.93	5.95	2.38	4.45	2.95	2.1	2.04	2.0	2.32
19	2.85	2.26	4.3	2.88	5.05	2.41	4.03	2.88	2.1	2.02	2.0	2.3
20	2.71	2.27	4.26	2.79	4.48	2.47	3.7	2.77	2.08	2.02	2.0	2.51
21	2.61	2.3	4.32	2.75	4.02	3.02	3.52	2.66	2.05	2.08	2.0	6.26
22	2.51	2.69	6.3	2.64	3.75	3.79	3.76	2.49	2.02	2.08	2.0	6.91
23	2.49	3.2	5.38	2.6	3.54	3.59	4.78	2.31	2.0	2.05	2.0	5.55
24	2.44	3.63	4.64	2.6	3.36	4.44	4.55	2.3	1.95	2.05	2.0	4.91
25	2.44	3.66	4.29	2.6	3.16	6.23	3.99	2.3	1.92	2.05	2.0	4.51
26	2.39	3.82	4.14	2.52	3.06	4.98	3.6	2.77	1.92	2.08	2.0	4.08
27	2.39	4.06	4.0	2.52	3.31	3.9	3.32	2.57	1.92	2.14	2.0	3.78
28	2.34	3.79	3.96	2.55	3.43	3.58	3.18	2.43	1.9	2.3	2.0	3.6
29	2.31	.....	3.69	2.55	3.22	3.19	3.42	2.36	1.9	2.29	2.0	4.28
30	2.29	.....	3.3	2.5	3.24	3.0	3.45	2.26	1.88	2.22	2.02	4.16
31	2.24	.....	3.49	.....	3.72	.....	3.17	2.24	.....	2.14	.....	3.92

NOTE.—Ice conditions during part of January.

Station rating table for James River at Buchanan, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	275	3.10	1,530	4.50	4,025	6.60	9,030
1.80	325	3.20	1,670	4.60	4,235	6.80	9,575
1.90	380	3.30	1,815	4.70	4,450	7.00	10,130
2.00	440	3.40	1,965	4.80	4,665	7.20	10,700
2.10	505	3.50	2,125	4.90	4,885	7.40	11,290
2.20	575	3.60	2,290	5.00	5,105	7.60	11,900
2.30	655	3.70	2,460	5.20	5,555	7.80	12,520
2.40	740	3.80	2,640	5.40	6,015	8.00	13,140
2.50	835	3.90	2,825	5.60	6,485	8.20	13,780
2.60	935	4.00	3,015	5.80	6,965	8.40	14,420
2.70	1,040	4.10	3,210	6.00	7,460	8.60	15,080
2.80	1,155	4.20	3,410	6.20	7,970	8.80	15,760
2.90	1,275	4.30	3,610	6.40	8,495	9.00	16,470
3.00	1,400	4.40	3,815				

NOTE.—The above table is applicable only for open channel conditions. It is based on 16 discharge measurements made during 1901-1905. It is well defined between gage heights 1.8 feet and 4.5 feet. From 4.5 to 8.5 feet it is determined by two measurements made in 1901. Above gage height 8.5 feet it is determined by the product of the area and velocity curves, but these are somewhat uncertain. A rock control below the station causes the discharge measurements to plot on a fairly permanent curve.

Estimated monthly discharge of James River at Buchanan, Va., for 1905.

[Drainage area, 2,058 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,352	533	1,154	0.561	0.647
February	3,132	428	1,012	.492	.512
March	25,370	2,109	5,488	2.67	3.08
April	3,857	835	1,619	.787	.878
May	17,380	723	3,898	1.89	2.18
June	8,048	599	1,720	.836	.933
July	42,860	1,167	5,393	2.62	3.02
August	1,572	607	1,006	.489	.564
September	2,207	369	671	.326	.364
October	655	352	475	.231	.266
November	505	440	444	.216	.241
December	9,878	472	2,641	1.28	1.48
The year	42,860	352	2,127	1.03	14.16

NOTE.—Ice conditions during part of January; estimates are for open channel.

JAMES RIVER AT HOLCOMB ROCK, VA.

This station was established by the Willson Aluminum Company, of Holcomb Rock, Va., in 1899 in connection with measurements to determine the horsepower available at that point. During 1899 the records were fragmentary, but at the beginning of 1900 daily records were taken, which have been furnished to the United States Geological Survey through the courtesy of the general manager of the company.

The gage consists of a copper float 8 by 8 by 8 inches, with a vertical rod 1½ inches square attached to it. The rod, which extends up through the power-house floor, is graduated to tenths of a foot. The copper float is inclosed in a 12-inch box, which rests solidly on the bottom of the river. The box is perforated, so that the water in it will always stand at the same level as the water in the river, while the float, being inclosed, is not in danger of being broken by floating timber. The fluctuations of the river are read directly from the rod, which moves up or down with the float as it responds to the variations in the height of the river.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Mean daily gage height, in feet, of James River at Holcomb Rock, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.0	2.6	2.2	1.4	2.3	1.7	1.8	1.2	0.7	1.2	0.9
2	1.2	1.0	3.3	1.9	1.4	2.0	1.6	1.6	1.6	.7	1.1	.8
3	1.3	.9	3.7	2.0	1.4	1.8	1.8	1.6	1.8	.8	1.0	1.4
4	1.2	.9	3.4	1.9	1.2	1.7	1.7	1.8	2.0	1.0	.3	3.0
5	1.2	.6	4.0	1.9	1.4	1.6	1.9	2.0	1.8	.9	.8	3.4
6	1.2	1.2	4.4	2.0	1.3	1.6	2.4	1.3	1.6	.8	1.0	2.4
7	2.3	1.2	3.8	2.8	1.1	1.5	6.6	1.6	1.4	.8	1.0	2.0
8	1.9	1.2	4.4	3.0	1.5	1.4	4.8	1.6	1.3	.6	1.0	1.6
9	1.6	1.2	5.2	2.6	1.6	1.4	4.5	1.8	1.2	.6	1.0	1.4
10	1.6	1.2	11.1	2.4	1.6	1.2	2.8	1.6	.6	.8	1.0	.9
11	1.6	1.2	8.8	2.3	1.6	1.0	2.4	1.6	1.2	.8	1.0	.9
12	1.6	1.4	7.5	2.2	6.7	1.2	2.8	1.6	1.2	1.1	.5	.8
13	3.5	1.5	5.2	2.2	9.5	1.3	15.6	1.2	1.2	1.0	1.0	.8
14	4.5	1.6	4.8	2.3	6.3	1.2	13.6	1.6	1.2	1.0	.8	.8
15	3.0	1.6	4.1	2.2	5.8	1.2	9.6	3.2	1.2	.8	.8	.8
16	2.6	1.6	3.6	2.0	8.4	1.2	6.5	2.3	1.2	1.0	.9	1.0
17	2.0	1.5	3.2	1.8	7.3	1.2	4.7	2.0	.9	1.0	.9	1.0
18	2.0	1.5	3.0	1.8	5.2	1.0	3.6	1.9	1.2	1.0	.8	1.0
19	1.8	1.5	3.1	1.7	4.3	1.3	2.9	1.8	1.2	.8	.2	1.0
20	1.7	1.6	3.1	1.6	3.6	1.4	2.6	1.6	1.1	.8	.8	1.2
21	1.6	1.4	3.0	1.6	3.0	1.6	2.4	1.6	1.0	.8	.9	1.6
22	1.4	1.6	5.6	1.5	2.6	2.6	2.5	1.5	.9	.7	.9	7.2
23	1.5	2.0	5.0	1.6	2.4	2.3	2.6	1.6	.9	.8	.9	8.4
24	1.4	2.2	3.8	1.6	2.2	3.0	3.6	1.3	.4	.8	.9	8.5
25	1.4	2.6	3.4	1.4	2.0	5.8	2.9	1.4	.8	.8	.9	6.8
26	1.1	2.7	3.2	1.4	1.8	4.3	2.4	1.7	.8	.9	.4	4.0
27	1.3	3.1	3.0	1.4	2.0	2.8	2.2	1.0	.8	1.0	1.0	2.6
28	1.2	2.7	2.8	1.4	2.0	2.4	2.0	1.5	.8	.8	.8	8.5
29	1.2	.....	2.6	1.5	2.1	2.0	1.5	1.4	.7	1.0	.8	8.4
30	1.1	.....	2.5	1.5	2.1	1.8	1.6	1.2	.7	1.2	.8	6.5
31	1.0	.....	2.4	.....	2.2	.....	1.9	1.2	.....	1.2	.....	4.5

JAMES RIVER AT CARTERSVILLE, VA.

This station was established January 1, 1899, by Prof. D. C. Humphreys. It is located at the highway bridge crossing the James between Pemberton and Cartersville, 300 yards from the railroad station, and 50 miles above Richmond, Va.

The channel is straight for one-third of a mile above the station and for 1 mile below. Both banks are high and will overflow only at extreme flood stages. The bed of the stream is composed of rocks and sand and is fairly permanent.

Discharge measurements are made from the lower side of the old wooden six-span highway bridge. The initial point for soundings is the lower corner of the right end post, downstream side.

The original wire gage was attached to a horizontal gage rod fastened to the bridge, and was referred to a bench mark—the top of the lower floor beam from the right bank—which was 32.04 feet above the zero of the gage. The original wire gage was replaced by a standard chain gage July 24, 1903. This is attached to the timbers of the second span from the right bank on the downstream side, at the same height as the hand rail. The length of the chain from the end of the weight to the marker is 37.98 feet. The gage is read once each day by B. W. Palmore, the postmaster. Bench mark No. 1 is a standard copper plug set in the capstone on the upstream side of the right abutment. It is inclosed by a ring of white paint and is marked by the letters "B. M. U. S. G. S. Hydro." Its elevation is 31.77 feet above

gage datum. Bench mark No. 2 is a spot of white paint on the inner eyebar of the lower chord of the bridge, under the pulley end of the gage box. Its elevation is 32.95 feet above gage datum. To provide for readings over 10 feet, two additional markers, 10.00 and 20.00 feet below the first, have been placed.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurement of James River at Cartersville, Va., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. feet.	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 17	A. H. Horton	3,928	2.41	4.60	9,468

Mean daily gage height, in feet, of James River at Cartersville, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	2.45	5.72	3.18	1.82	4.2	2.32	2.9	1.6	1.5	1.5	1.15
2	1.55	2.9	5.32	2.95	1.65	3.3	2.1	2.38	2.4	1.2	1.38	1.1
3	1.53	2.1	5.05	2.8	1.8	2.95	2.5	2.18	7.6	1.2	1.22	1.48
4	1.5	1.82	5.25	2.58	1.7	2.22	2.2	2.05	5.12	1.0	1.28	3.3
5	1.55	2.25	5.48	2.88	1.78	2.15	6.5	2.12	3.8	1.12	1.25	2.58
6	1.45	2.45	5.32	4.62	1.7	1.95	5.0	2.25	3.28	1.1	1.22	4.8
7	6.35	1.95	5.6	4.1	1.72	1.92	6.12	2.38	2.32	1.02	1.12	3.52
8	5.78	2.35	5.05	3.5	1.78	2.55	9.75	2.45	2.08	1.0	1.23	2.9
9	4.98	2.58	5.1	3.9	1.72	2.1	5.95	2.2	1.85	1.0	1.28	2.5
10	3.0	2.35	8.15	3.62	1.8	1.8	5.22	4.05	1.68	.95	1.22	2.9
11	2.6	2.65	12.1	3.6	1.7	1.5	4.55	5.0	1.58	1.0	1.2	2.82
12	2.8	2.7	9.85	3.82	4.7	1.48	4.05	3.55	1.5	2.58	1.12	2.2
13	4.28	2.9	8.1	4.22	9.82	1.38	7.1	2.9	1.58	2.3	1.2	2.1
14	4.05	3.32	6.68	4.1	11.9	1.38	16.39	2.9	1.5	1.8	1.1	1.88
15	5.48	3.55	5.75	3.78	8.42	1.3	16.0	7.05	1.45	1.58	1.03	1.8
16	4.42	3.0	5.08	3.55	9.6	1.35	11.4	8.6	1.3	1.45	1.2	1.9
17	3.5	2.85	4.55	3.25	10.85	1.35	8.55	5.05	2.5	1.42	1.15	2.0
18	3.12	2.85	4.25	2.85	9.12	1.35	6.35	4.0	3.7	1.2	1.15	2.4
19	2.85	2.6	3.98	2.7	7.12	1.3	5.15	3.15	2.92	1.22	1.1	2.42
20	2.48	2.7	3.95	2.52	5.68	1.25	4.52	2.65	2.21	1.22	1.12	2.7
21	2.5	3.37	4.0	2.4	4.68	4.5	4.5	2.48	1.85	1.2	1.08	10.99
22	2.2	4.05	4.5	2.32	4.25	3.25	3.85	2.2	1.58	1.12	1.02	12.9
23	2.1	5.38	5.6	2.2	3.58	1.98	8.5	2.15	1.45	1.05	1.22	9.8
24	1.88	5.3	6.22	2.08	3.15	7.3	5.22	1.95	1.35	1.0	1.22	8.62
25	1.9	4.7	5.1	2.05	2.85	5.12	5.25	2.1	1.28	1.0	1.2	6.45
26	1.8	5.45	4.82	2.1	2.58	5.8	4.1	5.3	1.22	1.25	1.2	5.39
27	1.9	6.55	4.3	2.02	2.5	5.75	3.55	2.9	1.12	1.52	1.15	4.68
28	2.0	5.4	4.2	2.0	2.5	4.15	3.1	2.55	1.12	1.6	1.05	4.05
29	2.45	.....	3.85	2.8	2.88	3.5	2.85	2.0	1.12	1.52	1.02	5.28
30	2.9	.....	3.62	1.92	2.9	2.82	4.1	1.9	1.12	1.38	1.15	6.38
31	2.65	.....	3.38	.....	3.4	.....	2.8	1.73	.....	1.35	.....	5.57

NOTE.—River frozen entirely across except for 50-foot channel under gage during latter part of January and the whole of February. Ice nearly 1 foot thick.

Station rating table for James River at Cartersville, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	480	2.40	4,280	4.60	9,280	8.60	20,940
0.30	615	2.50	4,490	4.70	9,530	8.80	21,620
0.40	755	2.60	4,700	4.80	9,780	9.00	22,300
0.50	900	2.70	4,910	4.90	10,040	9.50	24,000
0.60	1,050	2.80	5,120	5.00	10,300	10.00	25,750
0.70	1,200	2.90	5,330	5.20	10,820	10.50	27,500
0.80	1,355	3.00	5,550	5.40	11,350	11.00	29,260
0.90	1,510	3.10	5,770	5.60	11,890	11.50	31,080
1.00	1,670	3.20	5,990	5.80	12,430	12.00	32,930
1.10	1,830	3.30	6,210	6.00	12,980	12.50	34,780
1.20	2,000	3.40	6,440	6.20	13,540	13.00	36,670
1.30	2,170	3.50	6,670	6.40	14,100	13.50	38,570
1.40	2,350	3.60	6,900	6.60	14,680	14.00	40,520
1.50	2,530	3.70	7,130	6.80	15,260	14.50	42,500
1.60	2,710	3.80	7,360	7.00	15,860	15.00	44,500
1.70	2,900	3.90	7,590	7.20	16,460	16.00	48,600
1.80	3.090	4.00	7,830	7.40	17,080	17.00	52,820
1.90	3,280	4.10	8,070	7.60	17,700	18.00	57,200
2.00	3,480	4.20	8,310	7.80	18,330	19.00	61,700
2.10	3,680	4.30	8,550	8.00	18,970	20.00	66,300
2.20	3,880	4.40	8,790	8.20	19,620		
2.30	4,080	4.50	9,030	8.40	20,280		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 24 discharge measurements made during 1897-1905. It is well defined between gage heights 0.7 foot and 10 feet. The table has been extended beyond these limits. Between gage heights 10 feet and 20 feet the table is the product of the area curve by the extension of the velocity curve. Above 20 feet estimates are obtained in the same way with the addition of a small overflow discharge.

Estimated monthly discharge of James River at Cartersville, Va., for 1905.

[Drainage area, 6,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January (1-25) [a]	13,960	2,440	5,809	0.932	0.866
March	33,300	6,394	11,900	1.91	2.20
April	9,330	3,320	5,643	.905	1.01
May	32,560	2,805	9,388	1.51	1.74
June	16,770	2,085	5,309	.852	.951
July	50,230	3,680	13,490	2.16	2.49
August	20,940	2,957	6,086	.977	1.13
September	17,700	1,864	4,024	.646	.721
October	4,658	1,590	2,227	.357	.412
November	2,530	1,702	1,967	.316	.353
December	36,290	1,830	9,017	1.45	1.67

[a] Ice latter part of January and whole of February; no estimates made.

NORTH (OF JAMES) RIVER NEAR GLASGOW, VA.

This river rises on the western slope of the Shenandoah Mountains, flows southeastward across the valley between the Shenandoah and Blue Ridge ranges, and empties into James River about 17 miles south of Lexington, Va. Its drainage basin is largely under cultivation, except in the upper part, where it is mountainous and covered with forest growth.

The gaging station was established August 21, 1895, by C. C. Babb, assisted by D. C. Humphreys. It is located at the county bridge, three-fourths of a mile from the post-office at Glasgow, Va., and 1 mile above the mouth of North River.

The channel is straight for 600 feet above and below the station, and has a width of 240 feet, broken by two iron piers. Both banks are high, fringed with trees, and not liable to overflow except at very high water. The bed of the stream is rocky near the right bank, and is composed of rocks and mud near the left. The ten years' record at this station indicates a steady wearing away of the stream bed and increase in the slope, due to erosion at the controlling point below.

Discharge measurements are made from the lower side of the bridge to which the gage is attached. The initial point for soundings is the center of the end pin of the downstream truss on the left bank. Originally measurements were made from the sidewalk on the upstream side of the bridge. Beginning with 1902 measurements were made from the lower side of the bridge, owing to the removal of the sidewalk. The section at this side of the bridge is not as favorable for accurate measurements as that on the upper side, as it is obstructed by sunken logs and by the bridge piers.

The original gage was of the wire type. On July 22, 1903, a vertical gage rod was placed in position. This consists of a 2 by 6 inch oak timber, which is sunk to a firm foundation and securely nailed and braced to an overhanging tree on the right bank below the bridge. This gage was established on the same datum as the original wire gage and was read from the bridge. On November 24, 1903, a standard chain gage was established on the lower side of the bridge in the right span. Its datum is the same as that of the wire gage and rod gage which it replaced. The length of the chain from the end of the weight to the marker is 28.00 feet. During 1905 the gage was read once each day by B. G. Baldwin. Bench mark No. 1 is a standard copper plug set in the downstream end of the capstone of the right abutment. It is inclosed in a ring of white paint and is marked by the letters "B. M. U. S. G. S. Hydro." Its elevation is 23.89 feet above gage datum. Bench mark No. 2 is the upper surface of the upper chord over the pulley of the chain gage. Its elevation is 32.29 feet above gage datum.

This station was discontinued December 31, 1905. All records and estimates for years previous to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of North (of James) River near Glasgow, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 21	A. H. Horton	208	828	1.61	1.96	1,329
May 23	N. C. Grover	204	657	1.28	1.36	844
July 20	do	208	724	1.49	1.69	1,080

Mean daily gage height, in feet, of North (of James) River near Glasgow, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.6	0.85	1.6	1.4	0.85	1.1	1.4	1.0	0.7	0.35	0.5	0.5
2	.6	.9	2.25	1.35	.85	1.0	1.25	1.0	.9	.4	.5	.5
3	.6	.8	2.45	1.3	.85	1.0	1.2	.95	.85	.4	.5	1.2
4	.7	.8	2.1	1.3	.8	.95	1.1	.9	.8	.4	.5	2.0
5	.7	.7	2.55	1.3	.8	.9	1.2	.9	.8	.4	.5	1.65
6	.9	.65	2.3	1.4	.8	.85	1.2	.9	.75	.4	.5	1.5
7	1.7	.6	2.05	1.5	.8	.8	2.6	.9	.7	.4	.5	1.1
8	1.5	.7	2.25	1.25	.8	.8	2.5	.9	.7	.4	.5	1.0
9	1.1	.75	2.8	1.2	.75	.75	2.4	.9	.65	.4	.5	.9
10	.9	.75	5.4	1.1	.75	.7	2.0	.85	.65	.4	.5	.8
11	.9	.75	3.9	1.05	.75	.7	2.1	.8	.7	.45	.5	.75
12	1.2	.75	3.0	1.05	4.6	.7	5.2	.75	.6	.5	.5	.75
13	3.2	.75	2.8	1.1	3.6	.7	7.8	.75	.6	.5	.5	.7
14	2.5	1.8	2.4	1.0	2.5	.65	4.8	.7	.6	.5	.5	.7
15	2.0	1.0	2.15	.95	2.4	.65	3.6	.75	.6	.5	.5	.7
16	1.75	.9	2.1	1.0	2.25	.6	2.75	.8	.5	.5	.5	.7
17	1.5	.85	2.0	.95	2.0	.6	2.75	.9	.6	.5	.5	.7
18	1.3	1.25	1.8	1.0	1.9	.6	2.5	.9	.5	.5	.5	.7
19	1.2	1.0	1.75	1.0	1.85	.65	1.85	.9	.5	.5	.5	.7
20	1.2	.8	1.6	1.0	1.8	.8	1.7	.9	.5	.5	.5	.7
21	1.1	.8	1.8	1.0	1.65	1.0	1.6	.9	.5	.5	.5	1.25
22	1.0	.75	3.8	1.0	1.5	1.5	1.5	.9	.5	.5	.5	3.5
23	.9	.8	2.4	.95	1.4	2.5	1.7	.8	.5	.5	.5	2.5
24	.9	.95	2.2	.95	1.3	4.0	1.6	.8	.45	.5	.5	2.25
25	.85	1.5	2.1	.95	1.2	3.5	1.5	.75	.4	.5	.5	2.0
26	.8	1.6	2.0	.9	1.1	1.9	1.35	.75	.4	.5	.5	1.9
27	.8	2.05	1.9	.9	1.2	1.7	1.25	.8	.4	.5	.5	2.0
28	.8	1.5	1.75	.9	1.1	1.7	1.1	.8	.4	.7	.5	2.7
29	.8	.....	1.75	.9	1.0	1.6	1.0	.75	.4	.6	.5	2.7
30	.8	.....	1.6	.85	1.0	1.6	1.05	.75	.35	.55	.5	2.2
31	.8	.....	1.5	.....	1.1	.....	1.0	.7	.....	.5	.....	1.7

NOTE.—Gage heights slightly in error throughout the year, but not corrected, owing to uncertainty of all estimates at this station.

Station rating table for North (of James) River near Glasgow, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	165	1.60	1,015	2.90	2,560	4.40	5,390
.40	205	1.70	1,105	3.00	2,720	4.60	5,850
.50	250	1.80	1,200	3.10	2,880	4.80	6,330
.60	300	1.90	1,300	3.20	3,050	5.00	6,830
.70	350	2.00	1,400	3.30	3,220	5.20	7,350
.80	405	2.10	1,510	3.40	3,390	5.40	7,870
.90	465	2.20	1,620	3.50	3,570	5.60	8,410
1.00	530	2.30	1,740	3.60	3,750	5.80	8,950
1.10	600	2.40	1,860	3.70	3,940	6.00	9,490
1.20	675	2.50	1,990	3.80	4,130	6.50	10,890
1.30	755	2.60	2,120	3.90	4,330	7.00	12,340
1.40	840	2.70	2,260	4.00	4,530	7.50	13,830
1.50	925	2.80	2,410	4.20	4,950	8.00	15,380

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905 and on the direction of the curve of 1904. It is not well defined.

Estimated monthly discharge of North (of James) River near Glasgow, Va., for 1905.

[Drainage area, 831 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	3,050	300	705	0.848	0.978
February	1,455	300	547	.658	.685
March	7,870	925	1,928	2.32	2.68
April	925	435	596	.717	.800
May	5,850	378	1,049	1.26	1.45
June	4,530	300	834	1.00	1.12
July	14,760	530	2,032	2.45	2.82
August	530	350	431	.519	.598
September	465	185	294	.354	.395
October	350	185	240	.289	.333
November	250	250	250	.301	.336
December	3,570	250	949	1.14	1.31
The year	14,760	185	821	.988	13.50

APPOMATTOX RIVER AT MATTOAX, VA.

Appomattox River rises in eastern Appomattox County, flows in a general easterly direction, and unites with the James near Bermuda Hundred.

The gaging station was established August 27, 1900, by E. W. Myers. It is located on the two-span deck railroad bridge at Mattoax station, 27 miles southeast of Richmond, on the road to Danville.

The channel is straight for 400 feet above and 100 feet below the station. The current is moderately swift. The right bank is high and not subject to overflow; the left bank is high, but overflows beneath the second span of the bridge at high water. The bed of the stream is composed of rock and sand and is clean; it shifts during and after flood stages. There is but one channel at all stages, broken at extreme flood stages by the central pier of the bridge. The sand bottom beneath the second span is subject to change in high water.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the end of the downstream guard rail at the right bank. Distances along this rail are indicated by white paint.

The station is equipped with a standard chain gage, which is attached to the outside of the guard rail of the first span from the right bank. The length of the chain from the end of the weight to the marker is 48.80 feet. The gage is read morning and noon each day by J. C. Carter. A permanent bench mark, consisting of a United States Geological Survey standard iron post, was established August 29, 1903. This post is set at the northeast corner of the Mattoax passenger station, with an elevation of 48.68 feet above gage datum. Bench mark No. 2 is on the outer upstream edge of the top of the upper chord of the upstream truss, 111 feet from the initial point. Its elevation is 46.60 feet above gage datum. This station was discontinued December 31, 1905.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of Appomattox River at Mattoax, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 10	A. H. Horton	98	600	2.74	6.72	1,641
September 6	R. H. Bolster	73	223	1.75	2.39	390

Mean daily gage height, in feet, of Appomattox River at Mattoax, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.64	1.84	11.4	2.81	2.25	4.72	0.92	0.98	1.08	0.98	1.35	1.42
2	2.54	2.16	8.24	2.65	2.01	5.08	.92	.78	3.78	.88	1.3	1.28
3	2.36	2.59	8.14	2.48	1.93	3.28	1.4	.7	11.92	.98	1.3	2.12
4	2.62	2.56	5.69	2.43	2.03	2.38	1.45	.7	12.22	1.05	1.3	4.8
5	2.89	2.42	5.74	2.88	2.21	1.98	1.82	.68	4.72	1.3	1.25	4.75
6	2.52	2.22	5.26	6.48	2.15	1.78	8.0	4.25	2.62	1.3	1.28	3.2
7	8.96	2.14	4.39	9.08	2.63	1.7	4.65	3.18	2.08	1 05	1.35	1.98
8	10.3	2.66	4.02	6.45	2.78	1.7	3.72	1.35	1.78	.88	1.42	1.82
9	10.7	3.24	3.92	4.25	2.68	1.82	2.92	2.82	1.58	.85	1.3	2.1
10	4.72	2.62	6.62	3.55	2.28	1.7	2.58	1.98	1.32	.98	1.28	6.85
11	3.84	2.89	7.74	3.31	1.93	1.42	2.25	4.5	1.28	1.05	1.28	7.98
12	3.89	2.64	6.39	3.83	10.71	1.35	1.68	5.2	1.32	1.68	1.18	5.1
13	8.84	4.24	4.89	6.73	10.98	1.28	1.72	3.65	1.38	2.55	1.22	3.1
14	9.36	7.46	4.54	6.53	7.03	1.28	4.42	4.88	1.28	2.32	1.22	2.38
15	5.32	7.92	3.94	5.55	4.18	1.2	4.15	7.88	1.2	1.28	1.28	2.38
16	3.84	6.06	3.54	5.73	6.03	1.08	2.7	5.5	1.1	1.15	1.25	2.72
17	2.86	4.26	3.22	4.73	7.91	1.08	2.25	3.62	1.28	1.15	1.3	3.18
18	3.32	3.64	3.16	3.88	7.31	1.12	1.45	3.38	2.15	1.15	1.32	4.78
19	3.16	3.42	3.02	3.35	4.55	1.5	1.32	2.08	2.68	1.15	1.18	5.7
20	2.94	3.19	2.96	3.15	3.43	1.38	1.2	1.6	2.05	1.12	1.25	8.5
21	2.82	5.19	3.32	2.91	2.78	1.42	1.42	1.48	1.58	1.22	1.38	14.5
22	2.64	8.12	4.69	2.81	2.43	3.75	2.2	1.4	1.55	1.18	1.5	13.35
23	2.46	9.74	4.76	2.58	2.28	1.8	2.4	1.3	1.35	1.15	1.4	13.6
24	2.39	10.50	3.52	2.45	2.08	1.62	3.1	1.18	1.25	1.1	1.28	14.7
25	2.39	12.50	3.34	2.35	1.93	2.58	1.9	1.12	1.1	1.18	1.32	14.75
26	1.84	11.30	3.24	2.33	1.81	2.1	1.42	3.4	1.32	1.35	1.32	7.3
27	1.26	11.70	4.04	2.43	2.05	1.58	1.25	5.18	1.08	1.68	1.35	3.88
28	1.79	11.70	4.92	2.68	3.18	1.28	1.15	2.9	1.02	2.58	1.32	3.4
29	2.64	.....	3.84	2.55	2.88	1.08	1.02	1.8	1.05	2.38	1.28	6.85
30	2.09	.....	3.26	2.35	2.21	.98	1.02	1.3	.98	2.58	1.32	8 3
31	2.02	.....	2.99	.....	2.95	.....	1.05	1.25	.....	1.45	.....	8.38

Station rating table for Appomattox River at Mattoax, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	102	2.00	303	3.90	707	7.60	2,081
0.10	109	2.10	318	4.00	735	7.80	2,170
0.20	116	2.20	334	4.20	793	8.00	2,260
0.30	124	2.30	350	4.40	853	8.20	2,352
0.40	132	2.40	367	4.60	915	8.40	2,445
0.50	140	2.50	385	4.80	979	8.60	2,539
0.60	148	2.60	404	5.00	1,046	8.80	2,634
0.70	156	2.70	423	5.20	1,115	9.00	2,730
0.80	165	2.80	443	5.40	1,187	9.50	2,977
0.90	174	2.90	464	5.60	1,261	10.00	3,230
1.00	183	3.00	485	5.80	1,337	10.50	3,490
1.10	192	3.10	507	6.00	1,415	11.00	3,750
1.20	202	3.20	529	6.20	1,493	11.50	4,010
1.30	212	3.30	552	6.40	1,573	12.00	4,270
1.40	223	3.40	576	6.60	1,654	12.50	4,530
1.50	235	3.50	601	6.80	1,736	13.00	4,790
1.60	247	3.60	626	7.00	1,820	13.50	5,050
1.70	260	3.70	652	7.20	1,906	14.00	5,310
1.80	274	3.80	679	7.40	1,993	14.50	5,575
1.90	288						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900–1905. Estimates obtained from this table can be considered only approximate owing to the continual scour and fill at this section.

Estimated monthly discharge of Appomattox River at Mattoax, Va., for 1905.

[Drainage area, 745 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	3,594	208	892	1.20	1.38
February	4,530	280	1,443	1.94	2.02
March	3,958	477	1,074	1.44	1.66
April	2,769	355	776	1.04	1.16
May	3,740	275	807	1.08	1.24
June	1,073	181	321	.431	.481
July	2,260	176	407	.546	.630
August	2,206	154	511	.686	.791
September	4,384	181	549	.737	.822
October	400	170	229	.307	.354
November	235	200	213	.286	.319
December	5,710	210	1,710	2.30	2.65
The year	5,710	154	744	.999	13.51

ROANOKE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Dan River joins the Roanoke at Clarksville, Mecklenburg County, Va., 185 miles above its mouth, and is its largest tributary. The Roanoke drains a total area of 9,200 square miles, and empties into Albemarle Sound a short distance below Plymouth, N. C. It is navigable at all stages for 120 miles, to Weldon, N. C., where it crosses the fall line. The Dan and the Roanoke above their junction drain, respectively, 3,798 and 3,546 square miles. The Roanoke is the more northerly of the two, and its drainage basin lies entirely in Virginia. It rises among the eastern foothills of the Blue Ridge, southwest of Roanoke and Salem, and flows at first northeast, then southeast to its junction with the Dan. The Dan rises in Surry County, N. C., and Patrick County, Va., and flows at first southeast, then northeast to its junction with the Roanoke. A large part of the drainage area of the Dan lies in North Carolina.

During 1905 a survey of Roanoke River was made in order to determine a plan and profile and other information which would be of use in hydraulic developments. For description, plan, and profile of this survey see Bulletin No. 3 of the Geological Survey of Virginia.

The rainfall on the basin of the Roanoke above the fall line is about 48 inches per annum, and is evenly distributed throughout the year. The average amount probably increases slightly as the stream is ascended, though the records of rainfall over the basin are too incomplete to decide this matter. The slopes in the headwaters and in the upper tributaries are steep, freshets on the river are violent, and the fluctuations of height occur with great rapidity. Rises of 50 feet and over have been noted at Weldon, and freshets in which the rate of rise is 10 feet a day or more are frequent.

The United States Weather Bureau maintains gages at Clarksville, Va., at the junction of the Dan and Roanoke; on Dan River at Danville, Va., and on Roanoke River at Weldon, N. C.

Gaging stations were maintained during 1905 by the United States Geological Survey at the following points in this drainage basin:

Roanoke River at Roanoke and Randolph, Va.
Dan River at Madison, N. C., and South Boston, Va.
Mayo River at Madison, N. C.
Banister River near Houston, Va.

ROANOKE RIVER AT ROANOKE, VA.

This station was established July 10, 1896, by D. C. Humphreys. The gage is located at the Walnut Street Bridge, Roanoke, but the measuring section is at the Jefferson Street Bridge.

The channel is straight for 500 feet above the station and is sharply curved directly below. It has a width of 124 feet between abutments. The current is sluggish at low stages. The banks can overflow only at extreme flood stages. The bed of the stream is composed of hard clay, overlain by a shifting stratum of mud.

Discharge measurements were made from the Walnut Street Bridge, at which the gage is located, up to July 21, 1903. Since that time they have been made from the Jefferson Street Bridge, at which the section is more suitable. Crystal Spring overflows into the river between the gage and the measuring section. The initial point for soundings is the left end of the downstream hand rail of the bridge.

The original gage, of the wire type, was replaced November 28, 1903, by a standard chain gage. The datum is the same as that of the old gage. The length of the chain from the end of the weight to the marker is 27.50 feet. The gage is read once daily by Richard P. Royer. Bench mark No. 1 is the upper edge of the second floor beam from the left abutment, downstream side. Its elevation is 21.99 feet above gage datum. Bench mark No. 2 is a standard copper bolt set in the face of the lower wing wall of the left abutment about 4 feet above the ground. Its elevation is 19.71 feet above gage datum.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of Roanoke River at Roanoke, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 18	A. H. Horton	112	284	1.39	1.44	395
September 12	R. H. Bolster	116	323	.84	1.22	274

Mean daily gage height, in feet, of Roanoke River at Roanoke, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.8	0.8	1.85	1.25	1.0	1.4	0.9	1.95	1.03	0.9	0.9	0.8
2	.8	.7	2.5	1.15	.95	1.3	1.0	1.6	5.28	.9	.9	.8
3	.9	.65	2.3	1.1	.9	1.3	1.7	1.5	2.92	.9	.85	1.47
4	.9	.8	2.0	1.1	.95	1.25	1.85	1.4	2.15	.92	.8	1.55
5	.9	.8	2.1	1.1	.95	1.15	2.5	1.7	1.78	.9	.8	1.3
6	1.0	.75	1.85	1.6	1.0	1.1	3.05	1.45	1.53	.9	.8	1.2
7	1.15	.8	1.85	1.65	1.3	1.05	2.45	1.35	1.5	.82	.8	1.18
8	1.1	.8	1.95	1.55	1.15	1.0	2.1	2.0	1.3	.82	.8	1.15
9	.95	.7	2.7	1.45	1.1	.9	1.4	1.4	1.23	.85	.8	1.25
10	1.0	.8	3.6	1.4	1.1	.85	1.7	1.3	1.3	.85	.8	1.2
11	.95	.85	2.75	1.35	1.15	.85	2.1	1.35	1.28	1.12	.8	1.0
12	1.1	.8	2.2	1.4	4.72	.8	7.9	1.4	1.25	1.23	.8	.9
13	2.1	.8	2.0	1.45	4.0	.8	7.4	1.35	1.23	.92	.8	.9
14	1.75	.85	1.8	1.45	3.8	1.3	3.2	1.65	1.17	.85	.8	.9
15	1.45	.8	1.6	1.5	2.65	1.25	3.1	1.7	1.1	.83	.8	1.0
16	1.1	.9	1.6	1.5	3.7	1.2	2.6	1.5	1.1	.9	.8	1.0
17	1.15	.85	1.5	1.45	3.3	1.25	1.6	1.4	1.17	.85	.8	.95
18	1.15	.85	1.45	1.45	2.5	1.25	1.35	1.3	1.13	.85	.77	1.0
19	1.15	1.0	1.4	1.3	2.0	1.25	1.5	1.25	1.1	.87	.72	1.2
20	1.05	.95	1.1	1.3	1.9	1.4	1.75	1.2	1.03	.88	.78	4.3
21	1.0	1.3	1.3	1.25	1.65	2.75	1.85	1.15	1.0	.85	.88	2.3
22	.95	1.7	1.5	1.25	1.55	1.3	1.85	1.1	.95	.8	.82	1.0
23	.95	1.4	1.3	1.25	1.45	1.35	1.8	1.05	.97	.8	.8	1.9
24	.9	1.5	1.3	1.15	1.4	1.6	1.6	1.35	.95	.8	.8	1.8
25	.6	2.0	1.3	1.15	1.4	1.95	1.75	1.2	.92	.88	.8	1.7
26	1.1	2.2	1.3	1.1	1.35	1.5	1.55	1.9	.9	1.1	.8	1.6
27	.8	2.2	1.3	1.1	1.8	1.35	.....	1.4	.9	1.12	.9	1.65
28	.8	1.85	1.25	1.1	1.75	1.2	.....	1.3	.9	1.02	.82	1.6
29	.9	.....	1.25	1.05	1.6	1.1	.....	1.2	.9	.9	.8	1.55
30	.8	.....	1.2	1.0	1.5	1.0	.....	1.15	.9	.9	.8	1.4
31	.7	.....	1.25	.....	1.45	.....	2.1	1.1	.....	.9	.....	1.4

Station rating table for Roanoke River at Roanoke, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	74	1.30	310	1.90	655	2.50	1,140
.70	96	1.40	360	2.00	725	2.60	1,240
.80	122	1.50	415	2.10	800	2.70	1,340
.90	152	1.60	470	2.20	880	2.80	1,440
1.00	186	1.70	530	2.30	960	2.90	1,550
1.10	224	1.80	590	2.40	1,050	3.00	1,660
1.20	264						

NOTE.—The above table is based on discharge measurements made during 1896-1905. Above gage height 3 feet this table is the same as that for 1903 and 1904.

Estimated monthly discharge of Roanoke River at Roanoke, Va., for 1905.

[Drainage area, 388 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	800	74	213	0.549	0.633
February	880	85	259	.668	.696
March	2,390	224	620	1.60	1.84
April	500	186	316	.814	.908
May	3,877	152	802	2.07	2.39
June	1,390	122	317	.817	.912
July [a]	8,170	152	1,190	3.07	3.54
August	725	205	374	.964	1.11
September	4,633	152	469	1.21	1.35
October	278	122	157	.405	.467
November	152	101	126	.325	.363
December	3,310	122	425	1.10	1.27
The year	8,170	74	439	1.13	15.48

[a] Discharge interpolated July 27 to 30, inclusive.

ROANOKE[a] RIVER AT RANDOLPH, VA.

This station was originally established August 27, 1900, by E. W. Myers. It is located on the railroad bridge about five-eighths of a mile southwest of the Southern Railway station at Randolph.

The channel is straight for a considerable distance above and below the station and has a width at ordinary stages of about 400 feet, broken by one bridge pier. The bed is composed mainly of firm material and is quite permanent. The current is moderately rapid and has a well-distributed velocity. During flood stages the river flows under the four spans of the bridge and also through two flood channels through the railroad embankment between the bridge and Randolph station.

Discharge measurements are made from the bridge to which the gage is attached. The bridge makes an angle of about 73° with the direction of the current. The initial point for soundings is the end of the guard rail, left abutment.

During the summer of 1902 the bridge to which the gage was attached was replaced by a new one, a temporary gage, set by the observer, being used during the construction work; datum of temporary gage not known. On October 13, 1902, a new wire gage was installed. The gage heights before and after this date indicate that the datum was raised approximately 2.00 feet. The present gage, which was installed May 20, 1903, is a standard chain gage and occupies practically the same position as the wire gage which it replaced. It is attached to the upstream guard rail in the middle of the second span from the left bank. The datum is the same as that of the gage which it replaced. The length of the chain from the end of the weight to the marker is 43.13 feet. The gage is read once daily by J. E. Figg, the station agent. Bench mark No. 1 is the top of the floor beam nearest the zero of the gage scale, at a point 0.2 foot downstream from the adjacent tie. Its elevation is 41.97 feet above gage datum. Bench mark No. 2 is a copper bolt set in the capstone on the downstream side of the left abutment, about 3 feet from the end of the ties. Its elevation is 36.99 feet above gage datum.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

[a] Called Staunton River in previous reports.

Discharge measurements of Roanoke River at Randolph, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 11	A. H. Horton	277	2,580	3.19	11.18	8,233
July 23	Grover and Horton	262	1,601	3.01	7.58	4,820
September 7	R. H. Bolster	254	1,070	2.36	5.43	2,520

Mean daily gage height, in feet, of Roanoke River at Randolph, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	.....	9.8	4.3	4.2	6.7	7.1	5.2	5.2	3.3	3.45	3.95
2	3.7	.....	9.2	4.1	4.1	6.5	7.9	4.9	6.5	3.45	3.35	4.15
3	3.8	.....	8.6	4.2	4.3	6.0	8.4	4.7	19.93	3.45	3.4	4.25
4	4.3	.....	7.2	4.4	4.4	4.4	8.9	4.5	15.03	3.4	3.45	4.35
5	4.1	.....	7.4	5.2	4.2	4.5	9.5	4.4	9.8	3.35	3.45	4.5
6	3.8	.....	7.6	8.2	4.1	4.3	12.4	5.03	7.47	3.45	3.6	4.75
7	10.0	.....	7.8	7.6	4.0	4.2	14.8	5.73	5.63	3.35	3.45	4.8
8	12.9	.....	7.9	6.9	4.2	4.4	12.3	6.33	5.4	3.5	3.35	6.75
9	8.0	.....	7.7	6.2	4.3	4.2	9.4	6.67	5.43	3.65	3.45	7.0
10	5.5	.....	8.0	5.6	4.5	3.9	7.0	7.57	4.9	3.7	3.55	4.65
11	5.0	.....	11.07	4.8	7.8	3.6	8.2	7.73	4.47	3.75	3.55	4.75
12	5.1	.....	11.6	4.9	10.6	3.6	10.01	8.57	4.17	4.15	3.6	4.9
13	10.1	.....	11.4	5.4	11.8	3.5	15.45	8.4	4.27	5.6	3.45	4.75
14	9.7	.....	10.9	6.2	12.0	3.6	21.6	8.1	4.27	6.05	3.6	4.75
15	7.0	.....	9.8	6.4	10.8	3.5	12.78	7.73	4.23	5.55	3.45	4.65
16	5.6	.....	8.4	5.9	9.7	3.7	8.41	7.37	4.23	4.9	3.45	4.85
17	4.7	.....	6.9	5.8	8.85	3.6	8.81	6.43	4.2	3.7	3.55	5.15
18	5.0	.....	6.2	5.4	6.85	3.7	7.95	6.07	4.27	3.65	3.65	5.2
19	4.9	.....	6.1	5.1	7.0	3.6	6.78	5.77	4.03	3.5	3.55	5.4
20	4.8	.....	5.7	4.9	6.0	3.5	5.88	5.7	3.87	3.5	3.55	5.65
21	4.5	.....	5.8	4.7	5.9	3.7	5.48	5.5	3.77	3.65	3.45	5.55
22	4.3	10.5	5.6	4.4	5.8	3.6	5.21	5.2	3.87	3.65	3.55	5.45
23	4.1	11.9	5.4	4.2	5.6	3.5	8.48	4.37	3.7	3.65	3.55	5.65
24	3.8	12.1	5.2	4.0	5.5	12.0	10.05	4.17	3.5	3.45	3.65	13.35
25	3.5	11.4	5.1	3.9	5.7	11.8	6.91	4.1	3.17	3.6	3.55	21.85
26	3.2	11.0	5.3	4.3	5.8	9.6	6.51	4.3	3.17	3.9	3.65	16.8
27	3.3	10.8	5.4	4.2	6.0	8.8	5.85	4.23	3.33	3.75	3.65	12.05
28	3.2	10.2	5.2	4.1	8.3	8.3	5.28	4.33	3.3	3.65	3.75	10.0
29	3.4	.....	4.9	4.2	7.8	7.6	5.08	4.43	3.33	3.55	3.85	8.3
30	3.4	.....	4.6	4.3	7.6	6.6	5.28	4.47	3.47	3.65	3.75	8.1
31	3.4	.....	4.4	.....	6.9	.....	5.38	4.73	.....	3.6	.....	8.15

NOTE.—River frozen over January 28 to February 21.

Station rating table for Roanoke River at Randolph, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	920	4.50	2,030	5.90	3,205	7.60	4,780
3.10	985	4.60	2,110	6.00	3,290	7.80	4,980
3.20	1,050	4.70	2,190	6.10	3,380	8.00	5,180
3.30	1,120	4.80	2,270	6.20	3,470	8.50	5,680
3.40	1,190	4.90	2,355	6.30	3,560	9.00	6,190
3.50	1,260	5.00	2,440	6.40	3,650	9.50	6,715
3.60	1,330	5.10	2,525	6.50	3,740	10.00	7,250
3.70	1,405	5.20	2,610	6.60	3,830	10.50	7,800
3.80	1,480	5.30	2,695	6.70	3,920	11.00	8,350
3.90	1,555	5.40	2,780	6.80	4,010	11.50	8,900
4.00	1,630	5.50	2,865	6.90	4,105	12.00	9,470
4.10	1,710	5.60	2,950	7.00	4,200	12.50	10,050
4.20	1,790	5.70	3,035	7.20	4,390	13.00	10,650
4.30	1,870	5.80	3,120	7.40	4,580	13.50	11,250
4.40	1,950						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is fairly well defined between gage heights 2.6 feet and 14 feet.

Estimated monthly discharge of Roanoke River at Randolph, Va., for 1905.

[Drainage area, 3,076 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	10,530	1,050	2,773	0.901	1.04
February (22-28)	9,585	7,470	8,497	2.76	.718
March	9,010	1,950	4,601	1.50	1.73
April	5,380	1,555	2,576	.837	.934
May	9,470	1,630	3,974	1.29	1.49
June	9,470	1,260	2,891	.940	1.05
July	28,960	2,508	6,485	2.11	2.43
August	5,750	1,710	3,083	1.00	1.15
September	23,940	1,030	3,213	1.04	1.16
October	3,335	1,120	1,528	.497	.573
November	1,518	1,155	1,292	.420	.469
December	29,740	1,592	4,733	1.54	1.78

NOTE.—River frozen over January 28 to February 21. No correction made in January estimates.

DAN RIVER AT MADISON, N. C.

This station was established May 14, 1903, by E. W. Myers. It is located at the Southern Railway bridge about one-fourth mile from Madison and one-half mile above the mouth of Mayo River.

Above the station the channel is straight for about 600 feet and the velocity of the current is good. About 300 feet below the station the channel makes an abrupt turn. The right bank is low and overflows. There is a long trestle approach to the bridge on this side, and all water passes beneath the bridge and approaches. The left bank is low and overflows. A small stream enters from this side. The bed of the Dan is sandy, but is probably permanent. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the covered wooden two-span railway bridge and its wooden approaches. The initial point for soundings is the end of the guard rail of the trestle over the left bank.

The standard chain gage is located on the upstream side of the bridge, in the sixth panel of the first span from the left end. The length of the chain from the end of the weight to the marker is 35.24 feet. The gage is read once each day by J. W. Ore. Bench mark No. 1 is the edge of the top of a large wire nail driven flush into the top corner of the wooden floor beam beneath the gage box on the upstream side of the bridge. The point is indicated by the letters "B. M." in white paint. Its elevation is 34.10 feet above gage zero. Bench mark No. 2 is a standard iron bench-mark post set in cleared level ground on the left (south) side of the railway track. It is 77 feet west of the initial point for soundings and 9 feet south of the south rail of the track. Its elevation is 35.25 feet above gage zero.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 98, pp. 16-17; 126, pp. 100-101.
Discharge: WS 98, p. 17; 126, p. 101.
Discharge, monthly: WS 126, pp. 102-103.
Gage heights: WS 98, pp. 17-18; 126, pp. 101-102.
Rating table: WS 126, p. 102.

Discharge measurements of Dan River at Madison, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 21	B.S. Drane	140	257	2.35	1.67	603
April 21	do	140	257	2.30	1.67	590
August 21	do	146	336	2.30	2.17	773
September 18	do	140	258	1.67	1.32	431

Mean daily gage height, in feet, of Dan River at Madison, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.05	2.0	2.5	1.3	1.3	2.5	1.0	1.6	1.5	0.9	0.95	0.7
2	1.0	1.2	2.45	1.1	1.25	2.15	1.2	1.25	1.4	.85	.95	.8
3	1.0	.7	2.3	1.1	1.25	1.9	1.7	2.0	3.1	.9	.95	2.0
4	1.0	.8	2.1	1.1	1.2	1.5	1.4	3.1	2.75	.95	.9	1.3
5	.6	.7	2.0	1.8	2.9	1.4	4.5	3.0	2.3	.95	.9	1.2
6	.75	.9	1.9	6.8	8.0	1.4	5.0	1.9	1.5	.9	.9	1.15
7	7.8	1.4	1.8	3.6	5.6	1.3	3.0	1.55	1.6	.8	.9	1.1
8	2.8	1.25	1.6	2.3	4.8	1.2	1.5	4.8	1.6	.75	.9	1.0
9	1.5	1.0	1.5	2.0	2.75	1.15	1.65	2.5	1.4	.75	.85	1.5
10	1.6	1.45	2.1	1.65	2.2	1.1	3.0	4.8	1.35	.8	.85	6.0
11	1.4	1.65	3.9	1.4	2.5	1.1	2.9	5.1	1.4	1.15	.85	2.9
12	3.15	3.65	3.3	2.25	3.8	1.1	2.8	2.6	1.3	3.4	.85	1.8
13	5.2	4.6	2.7	3.7	5.1	1.2	7.5	4.2	1.2	1.5	.8	1.7
14	2.95	3.6	2.3	3.4	4.1	1.1	3.8	2.4	1.15	1.25	.8	1.5
15	1.5	2.2	1.9	3.2	2.75	1.05	3.0	2.6	1.1	1.15	.8	1.75
16	1.3	1.7	1.7	2.8	6.9	1.0	2.5	3.2	1.0	1.0	.75	2.0
17	1.2	1.6	1.6	2.5	4.0	1.1	2.05	3.9	1.2	1.0	.75	2.1
18	1.3	1.4	1.6	2.2	2.9	1.6	1.8	2.8	1.15	1.05	.75	2.0
19	1.3	1.4	1.5	2.0	2.1	1.3	2.45	2.35	1.15	1.0	.75	1.8
20	1.3	8.6	1.45	1.9	2.0	1.5	1.8	2.0	1.15	.95	.75	1.6
21	1.25	8.1	1.4	1.8	1.75	1.35	1.55	2.0	1.1	.95	.7	15.1
22	1.15	6.6	1.5	1.7	1.7	1.25	2.7	1.9	1.1	.9	.8	5.4
23	1.0	5.4	1.45	1.6	1.55	1.0	2.25	1.8	1.05	.95	.75	3.4
24	.95	4.2	1.3	1.5	1.6	1.9	1.9	5.55	1.0	.95	.75	3.5
25	.85	3.8	1.5	1.45	1.2	1.75	2.85	5.9	.95	1.0	.8	3.1
26	1.0	3.6	1.4	1.4	1.05	1.4	1.6	5.6	.95	1.1	.8	2.5
27	1.85	3.6	2.3	2.85	5.5	1.15	1.4	3.2	.9	1.05	.75	2.1
28	1.3	2.9	1.4	2.0	3.7	1.05	2.0	2.0	.85	1.0	.75	2.0
29	1.4	.....	1.4	1.85	5.8	.95	5.4	1.8	.8	1.0	.7	6.7
30	1.6	.....	1.4	1.5	5.2	1.0	3.5	1.65	.85	1.0	.7	3.4
31	1.8	.....	1.4	.....	3.0	.....	2.15	1.55	.....	1.0	.....	2.6

Station rating table for Dan River at Madison, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	180	0.80	330	1.40	508	2.00	710
0.30	204	0.90	358	1.50	540	2.10	744
0.40	228	1.00	386	1.60	574	2.20	778
0.50	252	1.10	416	1.70	608	2.30	813
0.60	278	1.20	446	1.80	642	2.40	849
0.70	304	1.30	476	1.90	676	2.50	885

NOTE.—The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1903-1905. It is well defined between gage heights 0.5 foot and 2.5 feet. Above 2.5 feet the discharge is only approximate.

Estimated monthly discharge of Dan River at Madison, N. C., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January	3,880	278	686
February	4,460	304	1,195
March	1,525	476	684
April	3,170	416	822
May	4,020	401	1,306
June	885	372	496
July	3,660	386	1,019
August	2.615	461	1,134
September	1,155	330	495
October	1,290	317	412
November	372	304	334
December	11,000	304	1,237
The year	11,000	278	818

DAN RIVER AT SOUTH BOSTON, VA.

This station was established August 27, 1900, by E. W. Myers. It is located in South Boston, on the Norfolk and Western Railway bridge, which crosses the river at that place.

This is a good station for the gaging of all except the highest stages of flow. At extreme heights the river spreads out over a flood plain of considerable width. The trestle connecting the bridge with the embankment on the south side of the river is a curve of rather high degree. The bed of the stream is of coarse sand and shifts slightly.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the left end of the downstream guard rail.

On May 18, 1903, the original wire gage was replaced by a standard chain gage referred to the same datum. The gage is located on the downstream guard rail near the center of the first span from the left bank. The length of the chain from the end of the weight to the marker is 35.02 feet. The gage is read twice daily by J. R. East. Bench mark No. 1 is the sharp inner corner, toward the left bank, of the plate attached to the inner surface of the struts at the center of the left span and furnishing a support to the wooden floor beam and tie. The elevation of the top of the plate is 32.88 feet above gage datum. Bench mark No. 2 is the top of a standard copper bolt set in the capstone of the abutment of the Southern Railway viaduct across the highway a short distance upstream from the crossing of the Norfolk and Western and the Southern railways. Its elevation is 30.68 feet above gage datum.

All records and estimates pertaining to this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of Dan River at South Boston, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 11	A. H. Horton	268	2,498	2.34	6.38	5,853
July 22	N. C. Grover	250	1,514	1.72	2.71	2,610
September 8	Bolster and Winter	244	1,280	1.35	1.78	1,734

Mean daily gage height, in feet, of Dan River at South Boston, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.60	1.17	4.55	1.70	2.05	7.48	1.45	2.48	1.35	1.28	1.40	1.55
2	1.59	1.25	4.07	1.62	1.82	3.68	1.50	1.95	3.30	.80	1.40	1.40
3	1.87	1.15	3.75	1.58	2.68	2.98	1.60	2.10	6.98	1.30	1.42	1.48
4	1.92	.95	3.55	1.62	4.95	2.60	2.72	1.98	4.65	1.30	1.25	2.80
5	1.65	.95	3.29	3.12	3.22	2.18	3.50	2.40	3.40	1.30	1.15	5.25
6	3.35	1.22	2.85	7.52	2.48	1.80	8.35	2.78	3.05	1.30	1.05	4.85
7	12.57	1.45	2.49	8.68	3.62	1.78	8.40	2.60	2.25	1.40	.95	3.50
8	9.29	1.39	2.52	5.20	5.48	2.02	6.70	2.30	1.75	1.22	.85	2.25
9	5.17	1.45	2.59	3.92	4.00	2.28	4.95	2.75	1.45	1.30	1.35	2.05
10	3.17	1.39	3.65	2.82	2.85	1.68	2.78	6.92	1.25	.80	1.32	2.65
11	2.92	2.09	6.49	2.58	2.55	1.75	1.98	10.80	1.30	1.15	1.32	4.75
12	5.70	3.29	5.92	5.68	5.30	1.62	3.50	8.35	1.50	4.10	1.15	4.30
13	9.35	6.29	5.32	7.88	10.12	1.42	10.25	5.75	1.55	3.25	.85	3.00
14	7.85	8.82	4.52	8.50	7.72	1.35	10.50	4.38	1.18	2.30	.88	3.15
15	4.60	6.62	3.70	11.60	6.05	1.30	8.68	4.00	1.02	1.70	1.65	3.40
16	2.99	4.02	3.00	11.62	9.58	1.18	5.80	8.88	1.30	1.05	1.35	4.55
17	2.02	2.85	2.68	6.65	10.05	1.48	3.30	4.70	1.05	1.40	1.40	4.30
18	1.97	2.75	2.38	4.52	7.02	1.65	2.48	4.35	1.20	1.52	1.42	4.95
19	2.25	2.89	2.28	2.80	4.68	1.78	2.05	2.08	1.05	1.35	1.55	3.58
20	2.29	4.09	2.22	2.82	3.08	1.40	1.82	2.35	1.20	1.25	1.00	4.80
21	2.07	14.47	2.28	2.55	2.52	1.82	1.98	1.95	1.02	1.50	1.32	6.85
22	1.85	15.59	2.20	2.32	2.22	1.55	2.72	1.75	1.10	1.02	1.50	13.92
23	1.67	10.45	2.08	2.15	2.05	1.28	3.55	2.50	.98	1.45	1.40	11.40
24	1.42	7.99	1.98	2.08	1.95	1.52	4.75	4.45	1.05	1.25	1.48	7.95
25	1.17	5.75	2.42	1.95	2.00	1.75	4.52	4.82	1.05	1.10	1.42	6.80
26	1.02	8.09	2.35	1.72	4.22	1.95	3.50	4.45	1.20	1.05	1.70	4.90
27	.89	7.29	3.38	4.18	14.90	1.95	2.15	3.80	1.30	1.65	1.65	4.45
28	.95	5.59	2.78	4.70	12.08	1.28	1.82	2.88	1.15	1.60	1.45	6.30
29	.95	.....	2.30	2.98	6.12	1.32	4.95	1.88	1.08	1.22	1.42	15.30
30	.99	.....	1.95	2.38	5.05	1.28	5.80	1.48	1.30	1.28	1.45	10.80
31	.99	.....	1.80	.....	7.32	.....	5.42	1.38	.....	1.55	.....	7.05

NOTE.—Gage heights interpolated November 5-7, inclusive.

Station rating table for Dan River at South Boston, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	400	2.40	2,186	5.40	4,709	10.00	9,700
0.10	451	2.50	2,265	5.60	4,892	10.20	9,980
0.20	510	2.60	2,345	5.80	5,077	10.40	10,260
0.30	574	2.70	2,425	6.00	5,264	10.60	10,540
0.40	642	2.80	2,505	6.20	5,453	10.80	10,820
0.50	713	2.90	2,585	6.40	5,644	11.00	11,100
0.60	786	3.00	2,665	6.60	5,838	11.50	11,815
0.70	861	3.10	2,746	6.80	6,034	12.00	12,540
0.80	937	3.20	2,827	7.00	6,234	12.50	13,265
0.90	1,014	3.30	2,908	7.20	6,434	13.00	14,000
1.00	1,091	3.40	2,989	7.40	6,638	13.50	14,750
1.10	1,168	3.50	3,070	7.60	6,845	14.00	15,500
1.20	1,245	3.60	3,152	7.80	7,055	14.50	16,310
1.30	1,323	3.70	3,234	8.00	7,275	15.00	17,180
1.40	1,401	3.80	3,317	8.20	7,495	15.50	18,100
1.50	1,479	3.90	3,400	8.40	7,715	16.00	19,100
1.60	1,557	4.00	3,484	8.60	7,945	17.00	21,650
1.70	1,635	4.20	3,653	8.80	8,175	18.00	24,600
1.80	1,713	4.40	3,824	9.00	8,415	19.00	27,800
1.90	1,791	4.60	3,997	9.20	8,655	20.00	31,200
2.00	1,870	4.80	4,172	9.40	8,905	21.00	34,700
2.10	1,949	5.00	4,349	9.60	9,160	22.00	38,300
2.20	2,028	5.20	4,528	9.80	9,425	23.00	42,000
2.30	2,107						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903 to 1905 and is fairly well defined. The table has been extended below gage height 0.75 foot. Below gage height 10.4 feet the table is the same as that published for 1904.

Estimated monthly discharge of Dan River at South Boston, Va., for 1905.

[Drainage area, 2,750 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	13,370	1,006	3,004	1.09	1.26
February	18,270	1,052	4,563	1.66	1.73
March	5,730	1,713	2,635	.958	1.10
April	11,990	1,541	3,992	1.45	1.62
May	17,160	1,729	4,845	1.76	2.03
June	6,720	1,230	1,867	.679	.758
July	10,400	1,440	3,927	1.43	1.65
August	10,820	1,385	3,382	1.23	1.42
September	6,214	1,076	1,709	.621	.693
October	3,568	937	1,463	.532	.613
November	1,635	976	1,337	.486	.542
December	17,720	1,401	5,020	1.83	2.11
The year	18,270	937	3,145	1.14	15.53

MAYO RIVER AT MADISON, N. C.

Mayo River rises in the eastern part of Patrick County, Va., flows first southeast, then south, and unites with the Dan at Madison, N. C.

The station was established as a bench-mark station April 16, 1904, by B. S. Drane. It is located about one-half mile from Madison, at the highway bridge on the road to Mayodan, N. C., and about 1,000 feet above the junction of Mayo and Dan rivers.

The channel is straight for about 600 feet above and 1,000 feet below the station. The current is swift. Both banks are high, wooded, and not liable to overflow. The bed of the stream is composed of sand, with some rocks along the left bank. There is but one channel. At low water all water passes under the left span; at higher stages under both spans. Two cotton mills about 3 miles upstream will control the flow at all times, and freshets in Dan River will also cause backwater at the station.

Discharge measurements are made from the downstream side of the two-span bridge resting on three stone piers. The initial point for soundings is over the left end of the bridge, downstream side.

The bench mark is the upper edge of a small tie plate on the upstream side of the bottom of the third strut from the left bank on the upstream side of the bridge. Its elevation is 28.00 feet above gage datum. Additional discharge measurements are given in Water-Supply Paper No. 126, page 106.

Discharge measurements of Mayo River at Madison, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 21	B. S. Drane	63	271	1.16	2.14	314
August 21	do	84	391	0.99	2.43	388

BANISTER RIVER NEAR HOUSTON, VA.

This river has its source in Pittsylvania County, Va., flows southwestward through this and Halifax County, and is tributary to Dan River at a point about 5 miles below South Boston. Its total drainage area is 520 square miles. The basin is hilly and generally in farming lands, with small forest areas.

The gaging station was established September 28, 1904, by R. H. Bolster. It is located at a covered highway bridge 1¼ miles below the railway station at Houston, Va., and about one-fourth of a mile below the mouth of Terrible Creek.

The channel is straight for about 1,000 feet above and below the station. Both banks are low and liable to overflow. The bed of the stream is of gravel and sand, and probably changes somewhat. There is one channel, broken by one pier at low water and by two piers at medium stages.

Discharge measurements were made from downstream side of the covered highway bridge. The initial point for soundings is the left end of the bridge.

A standard chain gage is attached to the upstream side of the bridge near the left pier. The length of the chain is 33.53 feet. The gage was read twice daily by J. A. Yates. A staff gage at the mouth of Terrible Creek has been set to read the same as the chain gage, at 2.40 feet above gage datum. Observations were made from the staff gage, except in high water, at which time the chain gage was used. A high-water gage from 19 to 30 feet is painted on the northeast corner of Mr. Yates's mill. The datum of the gage is referred to bench marks as follows: No. 1 is a chiseled cross at the top of the left abutment, upstream side of the bridge; elevation, 25.27 feet. No. 2 is the top of foundation at northeast corner

of Mr. Yates's mill, directly under the high-water gage; elevation, 19.09 feet. No. 3 is a nail in a 10-inch tree 50 feet northeast of bridge over Terrible Creek; elevation, 16.48 feet.

This station was discontinued December 31, 1905, owing to unsatisfactory conditions.

All records and estimates for this station for years prior to 1906 have been revised and republished in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Discharge measurements of Banister River near Houston, Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
March 13	A. H. Horton	82	441	2.05	5.95	903
September 8	Bolster and Winter	70	158	1.20	2.17	189

Mean daily gage height, in feet, of Banister River near Houston, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.88	2.85	5.95	3.3	3.05	7.7	2.05	2.15	1.85	1.58	2.1	2.05
2	2.9	3.0	5.5	3.0	2.85	5.5	2.2	2.1	3.5	1.52	2.0	2.0
3	2.9	2.95	4.88	2.95	3.35	3.75	2.4	4.55	5.25	1.98	1.95	3.55
4	3.5	2.85	4.6	2.92	4.15	3.25	2.6	2.5	3.9	1.9	2.0	4.6
5	2.6	2.85	4.3	4.5	3.65	3.05	2.55	3.6	2.8	1.75	2.05	3.3
6	3.45	2.22	4.1	8.92	3.18	2.9	3.65	2.2	2.25	1.7	2.05	2.45
7	12.95	2.95	3.9	6.6	3.15	2.7	4.6	2.05	2.1	1.65	2.1	2.25
8	9.55	3.25	3.72	4.95	3.0	2.75	4.0	2.32	1.98	1.72	2.05	2.42
9	6.3	2.85	4.9	4.15	2.98	2.6	2.95	2.75	1.95	1.52	2.05	4.4
10	4.4	3.1	6.35	3.85	2.75	2.45	2.85	5.05	1.85	1.45	2.05	8.85
11	4.0	3.65	7.1	3.7	2.6	2.45	2.35	4.95	1.95	2.62	2.0	5.55
12	6.55	4.25	6.0	9.45	4.1	2.4	3.75	4.62	2.0	4.05	1.98	3.98
13	9.15	8.15	5.9	10.95	5.2	2.45	6.9	3.45	2.0	2.78	2.05	3.2
14	6.58	7.25	5.2	8.45	5.95	2.3	6.55	3.2	1.92	2.22	1.95	3.0
15	4.5	5.35	4.32	8.35	4.35	2.3	4.75	5.05	1.68	2.0	2.1	3.25
16	3.55	4.05	4.05	7.0	5.55	2.22	2.95	4.75	1.65	1.9	2.1	3.85
17	3.65	3.95	3.68	5.25	5.75	2.52	2.5	3.3	2.05	1.85	2.05	4.92
18	3.95	3.85	3.6	4.6	4.55	2.5	2.4	2.6	2.22	1.95	2.1	5.15
19	3.62	3.95	3.5	4.2	3.35	2.3	2.25	2.4	2.05	1.95	2.05	4.4
20	3.52	7.0	3.4	3.85	3.0	2.25	2.1	2.2	2.2	2.1	2.25	3.88
21	3.38	12.95	3.75	3.7	2.8	2.15	2.05	2.15	1.98	2.1	2.35	12.75
22	3.22	14.35	3.7	3.55	2.7	2.05	4.9	2.1	1.85	2.05	2.3	16.45
23	3.25	10.4	3.42	3.4	2.6	2.0	4.85	2.0	1.8	1.95	2.1	9.8
24	3.15	7.55	3.2	3.28	2.6	3.7	3.35	1.9	1.7	2.0	2.18	6.5
25	2.9	8.05	4.8	3.2	2.5	4.6	2.8	2.35	1.65	2.05	2.15	5.0
26	2.32	9.3	4.3	3.1	2.8	2.95	2.5	2.85	1.65	2.68	2.12	4.15
27	2.55	8.0	4.85	3.55	8.75	2.55	2.1	2.35	1.65	2.7	2.1	3.85
28	2.95	6.2	4.3	3.4	7.2	2.3	3.15	2.2	1.6	2.5	2.08	3.6
29	2.95	.....	3.7	3.2	5.8	2.15	3.1	2.0	1.58	2.25	2.05	11.1
30	2.95	.....	3.55	3.2	7.5	2.1	2.7	1.9	1.52	2.2	2.1	8.05
31	2.88	.....	3.4	.....	5.6	.....	2.4	1.8	.....	2.1	.....	6.3

PEDEE, OR YADKIN, RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yadkin River, or the Pedee, as it is called below the junction with the Uharie, rises on the eastern slope of the Blue Ridge, in Caldwell and Watauga counties, N. C., and flows at first southeastward, then turns abruptly to the northeast, and after flowing in this direction for about 60 miles again bends abruptly and flows southward and southeastward across North Carolina and South Carolina, emptying into Winyah Bay at Georgetown, S. C. The total length of the stream from source to mouth, in its general direction, is from 275 to 300 miles, but with all the windings it is probably 400 miles or more.

The Pedee drains a total area of about 17,000 square miles, of which 9,700 square miles are in North Carolina and 7,300 in South Carolina. It crosses the fall line near Cheraw, S. C., in a series of rapids extending over a number of miles, with no very great fall at any one place or in any short distance.

The upper part of the drainage basin is rough and mountainous and is largely forest covered, and throughout this part of its course the flow of the stream is more constant than would be expected. Below the great bend, where the river turns to the south, the valley averages about 50 miles in width. At many points the river is bordered by wide expanses of bottom lands, at times subject to overflow, which are fertile and very productive. At other places the stream is confined between bold and abrupt banks, and in one place it flows for several miles in a narrow channel, parts of which are only 60 feet wide, in a deep ravine between the flanking hills, forming the noted "Narrows." Above the great bend the valley is from 15 to 20 miles wide, and the elevations of the divides which separate the basin of the Yadkin from adjacent drainage basins are much higher, so that the tributary streams have a large fall.

Small amounts of power may be developed on some of the tributaries of this river in South Carolina, but the power possibilities of the basin in this State are unimportant. In North Carolina both the main stream and many of its tributaries can be made to furnish power in large amount at a number of places, and for this reason they are among the most important power streams in the Southern States.

The average rainfall over the part of the basin in North Carolina is probably between 48 and 51 inches, approximating the smaller figure over the lower portions, and possibly exceeding the larger over the higher and more mountainous portions, the precipitation increasing toward the head of the stream. The total amount is rather evenly distributed among the seasons.

The highest flood ever known at Wilkesboro, it is stated, occurred in March, 1899, the stream at this place rising 28 feet above low water. The greatest flood recorded at the gaging station at Salisbury occurred in December, 1901, the stream reaching an extreme height on the gage of 19.7 feet and having a probable discharge of about 130,000 second-feet, or about 38 second-feet per square mile. The flood of March, 1899, produced a rise of about 1 foot less than this flood of December, 1901. The most destructive flood ever experienced on the river occurred in May, 1901, but the recorded gage height at the Salisbury station was less for this flood than for either of the others mentioned, and the general testimony of those living along the banks is to the same effect.

The minimum recorded flow at the Salisbury station occurred in September, October, and November, 1897, when the basin experienced the most severe drought in its history. The flow fell to 900 second-feet several times during this period, i. e., the basin above the station was discharging at an average rate of 0.26 second-foot per square mile. The maximum flow is thus about 144 times the minimum.

The United States Weather Bureau maintains river stations on the Pedee at Cheraw and at Smiths Mills, S. C.

During 1905 the United States Geological Survey has maintained gaging stations in this drainage basin as follows:

Yadkin River near Salisbury, N C., and at North Wilkesboro, N. C.
Reddie River at North Wilkesboro, N. C.
Mulberry River near North Wilkesboro, N. C.
Roaring River at Roaring River, N. C.
Mitchell River at Burch, N. C.
Ararat River near Siloam, N. C.

YADKIN RIVER NEAR SALISBURY, N. C.

This station was established September 24, 1895, by C. C. Babb. It is located at the Southern Railway bridge, about 6 miles east of Salisbury, N. C.

The bridge is a four-span iron bridge of the deck type, having a total length of about 650 feet between stone abutments. The left-bank abutment is at the edge of a high, rocky bluff, and that at the right bank is connected with the hill by a short earth embankment. The river is confined by the abutments at all stages and occupies practically the whole width at low water. The channel is straight for a long distance below the station, but curves considerably above. The bed of the river is rocky, and the depth of the water is fairly uniform. The current is good, even at the lowest stages.

Discharge measurements are made from the walk to which the gage is attached. The initial point for soundings is the end of the bridge at the right bank.

In 1899 the location of the original wire gage and of the measuring station was changed from the railway bridge to a new iron highway bridge about 300 yards above, the gage being set to read the same as the original one. Early in 1903 it was decided that the original location was better, so the station was changed back to the railroad bridge.

The new gage is a standard chain gage and is fastened to the lower member of the bridge along the plank walk, near the middle of the first span from the right bank. The length of the chain from the end of the weight to the marker is 28.66 feet. The gage is read once daily by J. T. Yarbrough, the bridge keeper. Bench mark No. 1 is the top of the inside eyebar of the lower chord on the downstream side, in the fourth panel from the right end of the bridge, opposite a point 80 feet from the initial point for soundings. It is marked with white paint and has an elevation of 27.28 feet above gage datum. Bench mark No. 2 is the top of the anchor-bolt head at the right downstream corner of the foot plate on the right abutment, downstream side. Its elevation is 26.82 feet above gage datum. Bench mark No. 3 is a copper plug set in solid rock near the Piedmont toll bridge, one-fourth of a mile above the gage. It is on the upstream side of the road, 40 feet from the right-bank end of the bridge and 6 feet upstream from the line of the edge of the bridge. Its elevation is 33.06 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water Supply Paper):

Description: Ann 18, iv, p 57; WS 15, p 32; 27, p 26; 36, pp 116-117; 48, pp 139-140; 65, p 246; 83, pp 61-62; 98, p 32; 126, pp 109-110.

Discharge: Ann 18, iv, p 58; WS 15, p 32; 27, p 44; 36, p 117; 48, p 140; 65, p 246; 83, pp 62, 64; 98, p 33; 126, p 110.

Discharge, minimum: WS 36, p 119.

Discharge, monthly: Ann 18, iv, p 59; 19, iv, p 201; 21, iv, p 120; 22, iv, p 156; WS 75, p 57; 83, p 64; 98, p 34; 126, p 112.

Discharge, yearly: Ann 20, iv, p 50.

Gage heights: WS 11, p 17; 15, p 32; 27, p 36; 36, p 117; 48, p 140; 65, p 246; 83, p 63; 98, p 33; 126, pp 110-111.

Hydrographs: Ann 18, iv, p 59; 19, iv, p 201; 20, iv, p 147; 21, iv, p 121; 22, iv, p 156; WS 75, p 57.

Rating tables: Ann 18, iv, p 58; 19, iv, p 200; WS 39, p 443; 52, p 512; 65, p 320; 83, p 63; 98, p 34; 126, p 111.

Discharge measurements of Yadkin River near Salisbury, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
January 7	B. S. Drane	539	3,108	3.28	4.50	10,210
January 13	J. M. Giles	505	4,083	4.16	6.20	16,990
January 13	do	575	3,660	4.39	6.05	16,070
April 20	B. S. Drane	536	1,579	2.15	2.34	3,390
April 29	do	468	2,128	1.34	2.22	2,846
June 24	do	468	2,194	1.44	2.22	3,170
August 19	do	470	2,338	1.94	2.74	4,530
September 21	do	432	1,959	1.15	1.85	2,260

Mean daily gage height, in feet, of Yadkin River near Salisbury, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	1.85	3.0	2.0	2.1	2.6	1.6	2.35	1.95	1.55	1.70	1.6
2	2.0	1.9	2.85	2.0	1.85	2.15	1.9	2.0	1.9	1.7	1.65	1.6
3	1.85	1.8	2.7	2.0	1.85	1.85	2.25	1.9	2.2	1.6	1.65	1.8
4	1.9	1.7	2.6	1.8	2.0	2.0	2.05	1.9	2.4	1.6	1.6	4.1
5	1.8	1.75	2.55	1.85	2.15	2.0	2.55	2.1	2.1	1.7	1.6	3.2
6	1.65	1.7	2.5	3.0	3.6	1.75	5.0	2.75	2.9	1.65	1.75	2.25
7	3.6	1.7	2.25	3.9	5.4	1.7	5.0	2.6	2.1	1.6	1.65	1.9
8	4.4	2.15	2.2	3.0	5.6	1.7	3.2	2.25	2.0	1.5	1.65	1.8
9	3.3	1.8	2.3	2.5	4.4	1.6	2.45	4.4	1.9	1.6	1.65	1.9
10	2.4	1.85	2.3	2.4	2.95	1.65	2.5	3.7	1.95	1.5	1.6	5.3
11	2.3	2.35	2.7	2.15	4.5	1.65	2.85	6.7	2.0	1.6	1.6	4.9
12	2.35	2.5	2.85	2.15	3.8	1.75	3.1	6.8	1.8	3.6	1.55	3.3
13	6.0	3.6	2.95	5.2	4.3	1.65	8.2	7.5	2.05	2.9	1.7	2.55
14	5.3	4.8	2.7	3.5	4.2	1.6	9.5	5.9	1.8	2.0	1.6	2.25
15	3.6	3.8	2.5	4.8	4.4	1.7	8.4	4.2	1.75	1.8	1.6	2.2
16	2.9	2.95	2.3	3.6	4.3	1.55	6.9	4.0	1.7	1.9	1.6	2.8
17	2.35	2.5	2.2	3.0	5.0	1.65	4.4	3.2	1.7	1.7	1.6	3.1
18	2.1	2.6	2.1	2.5	4.0	2.2	3.4	3.2	1.9	1.75	1.6	2.85
19	2.2	2.5	2.2	2.3	3.1	2.3	2.8	2.7	1.85	1.7	1.6	2.5
20	2.1	2.5	2.2	2.2	2.65	2.4	2.8	2.55	1.8	1.7	1.75	2.35
21	2.0	8.1	2.1	2.05	2.5	2.2	2.5	2.55	1.8	1.7	1.6	5.7
22	2.1	8.4	2.1	2.05	2.4	2.05	2.4	3.0	2.0	1.65	1.65	9.1
23	2.0	7.0	2.1	2.15	2.15	1.8	3.0	2.8	1.8	1.7	1.65	5.8
24	1.85	5.8	2.0	2.15	2.2	1.8	2.75	2.8	1.75	1.65	1.6	4.0
25	1.9	4.5	2.0	1.95	2.1	2.2	2.35	3.0	1.8	1.7	1.6	3.4
26	1.7	4.2	2.2	1.9	2.0	2.1	2.5	3.3	1.65	1.65	1.6	2.95
27	1.3	3.8	2.25	2.0	2.25	1.75	2.1	3.8	1.65	1.8	1.6	2.7
28	1.25	3.4	2.1	2.25	2.85	1.65	2.0	2.35	1.6	1.9	1.6	2.5
29	1.85	.....	2.05	2.1	2.05	1.55	3.2	2.1	1.6	1.85	1.6	3.4
30	1.95	.....	2.0	2.1	2.15	1.65	3.4	2.05	1.6	1.8	1.6	3.4
31	1.9	.....	1.95	.....	2.55	.....	3.0	2.0	.....	1.7	.....	2.95

Station rating table for Yadkin River near Salisbury, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	1,050	2.70	4,400	4.30	9,510	6.60	18,650
1.20	1,170	2.80	4,675	4.40	9,850	6.80	19,570
1.30	1,300	2.90	4,995	4.50	10,200	7.00	20,500
1.40	1,445	3.00	5,300	4.60	10,550	7.20	21,440
1.50	1,600	3.10	5,610	4.70	10,910	7.40	22,400
1.60	1,770	3.20	5,920	4.80	11,270	7.60	23,380
1.70	1,950	3.30	6,235	4.90	11,630	7.80	24,380
1.80	2,140	3.40	6,550	5.00	12,000	8.00	25,400
1.90	2,340	3.50	6,870	5.20	12,750	8.20	26,450
2.00	2,550	3.60	7,190	5.40	13,520	8.40	27,520
2.10	2,775	3.70	7,515	5.60	14,320	8.60	28,620
2.20	3,015	3.80	7,840	5.80	15,150	8.80	29,740
2.30	3,270	3.90	8,170	6.00	16,000	9.00	30,880
2.40	3,540	4.00	8,500	6.20	16,870	9.20	32,040
2.50	3,820	4.10	8,830	6.40	17,750	9.40	33,220
2.60	4,110	4.20	9,170				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 26 discharge measurements made during 1901, 1904, and 1905. It is well defined between gage heights 1.4 feet and 6.2 feet. The table has been extended beyond these limits, being based on two measurements at 10.5 feet. Below 3 feet the table is the same as for 1904.

Estimated monthly discharge of Yadkin River near Salisbury, N. C., for 1905.

[Drainage area, 3,399 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	16,000	1,235	4,007	1.18	1.36
February	27,520	1,950	7,107	2.09	2.18
March	5,300	2,445	3,447	1.01	1.16
April	12,750	2,140	4,153	1.22	1.36
May	14,320	2,240	5,977	1.76	2.03
June	4,110	1,685	2,332	.686	.765
July	33,820	1,770	7,835	2.31	2.66
August	22,890	2,340	6,678	1.97	2.27
September	4,995	1,770	2,381	.700	.781
October	7,190	1,600	2,221	.653	.753
November	2,045	1,685	1,818	.535	.597
December	31,460	1,770	6,513	1.92	2.21
The year	33,820	1,235	4,539	1.34	18.13

YADKIN RIVER AT NORTH WILKESBORO, N. C.

This station was established April 10, 1903, by E. W. Myers. It is located at the lower highway bridge between Wilkesboro and North Wilkesboro, about one-half mile below North Wilkesboro railroad station and three-fourths of a mile below the mouth of Reddie River.

The channel is straight above the station, but it makes a very slight curve beneath the bridge. Below the station the channel is straight for about 600 feet. The water is swift both above and below. The right bank is low and subject to overflow, but all water must pass beneath the bridge and its approaches. The left bank is high and rocky and does not overflow at the bridge, but is subject to overflow above. The bed of the stream is rocky, with sand in places. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The bridge consists of a single steel span, about 125 feet long, under which the river flows at ordinary stages, and three wooden spans of about 50 feet each on the right bank. There are also wooden trestle approaches about 170 feet long on the right bank and about 40 feet on the left bank. The initial point for soundings is the end of the downstream guard rail at the left end of the bridge. Distances are measured along this guard rail and are marked in white paint.

The scale of the standard chain gage is fastened to the downstream guard rail, with its zero 7.63 feet east of the center of the second strut from the west end of the span. The distance from the end of the weight to the marker is 33.38 feet. The gage is read once each day by U. H. Wyatt. Bench mark No. 1 is the top surface of the outer eyebar of the lower chord opposite a point 100 feet from the initial point for soundings. Its elevation is 30.75 feet above gage datum. Bench mark No. 2 is the top of the downstream end of the third floor beam from the left bank. Its elevation is 30.33 feet above gage datum. Bench mark No. 3 is a copper plug set in rock in the face of the railroad cut on the left bank of the river, 21 feet to the left of the center of the railroad track and 15 feet downstream from the line of the lower side of the highway bridge. Its elevation is 28.90 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers published by the United States Geological Survey: Description: 98, p 35; 126, pp 112–113. Discharge: 98, p 36; 126, p 113. Discharge, monthly: 98, p 37; 126, p 115. Gage heights: 98, p 36–37; 126, pp 113–114. Rating table: 98, p 37; 126, p 114.

Discharge measurements of Yadkin River at North Wilkesboro, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
January 3	B. S. Drane	93	290	2.15	0.30	580
January 4	do	92	252	1.98	.00	465
April 25	do	94	306	1.94	.34	593
April 26	do	94	313	2.04	.50	638
August 22	do	95	319	2.58	1.02	824
August 23	do	96	330	2.66	1.23	878
September 19	do	94	272	2.09	.53	567

Mean daily gage height, in feet, of Yadkin River at North Wilkesboro, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.25	0.2	1.3	0.35	0.3	0.3	0.75	0.4	0.6	0.2	0.2	0.15
2	.2	.2	1.3	.35	.25	.25	.9	.3	.7	.2	.2	.15
3	.25	.1	1.15	.3	.3	.25	3.1	.35	.75	.2	.2	5.1
4	.05	−.15	1.0	.3	.8	.2	.8	1.1	6.9	.4	.2	1.4
5	.15	.0	1.0	.4	.4	.2	.6	1.4	1.7	.25	.2	.7
6	.3	.2	.95	1.1	.8	.15	1.65	.7	1.1	.2	.2	.5
7	2.0	.2	.85	.65	2.65	.1	.7	.55	.9	.2	.2	.5
8	.55	.3	.75	.5	1.2	.15	.4	2.75	.75	.2	.2	.4
9	.15	.1	.75	.4	.8	.05	.45	4.0	.65	.2	.2	3.6
10	.5	.2	1.4	.5	.6	.0	.3	3.0	.6	.2	.2	2.7
11	.35	.3	1.2	.45	1.35	.0	.5	2.4	.6	3.8	.2	1.4
12	4.2	.4	1.05	3.8	.65	.0	8.6	4.3	.6	1.05	.2	.95
13	3.2	2.1	1.1	2.15	1.3	.0	12.50	2.8	.6	.5	.2	.8
14	1.7	.8	.85	1.8	3.6	.0	6.6	2.6	.5	.35	.2	.7
15	.9	.55	.75	1.3	1.9	.0	3.5	1.85	.5	.3	.2	.95
16	.4	.2	.65	1.15	4.1	.25	3.5	2.2	.5	.25	.2	1.7
17	.4	.55	.6	.85	3.0	.4	1.9	1.5	.65	.25	.2	1.2
18	.5	.15	.55	.7	1.9	.4	1.4	1.3	.5	.25	.2	1.05
19	.45	.3	.55	.6	1.4	2.4	1.45	1.25	.5	.25	.2	.9
20	.3	.65	.5	.6	1.1	1.65	.95	1.15	.5	.25	.25	.85
21	.3	3.7	.65	.5	.85	.8	.8	1.1	.45	.25	.25	8.1
22	.25	3.4	.6	.5	.75	.5	.9	1.15	.4	.2	.2	2.85
23	.2	3.4	.45	.4	.9	.5	.8	.9	.3	.2	.1	1.95
24	.1	2.5	.5	.4	.75	1.1	.65	1.0	.3	.2	.1	1.7
25	−.15	2.0	.7	.35	.55	.65	.65	1.0	.25	.25	.15	1.35
26	−.6	1.8	.5	.4	.7	.4	.5	1.6	.2	.65	.15	1.1
27	.2	1.55	.6	.85	1.0	.3	.4	.9	.2	.4	.15	.95
28	.45	1.35	.4	.5	.6	.15	.5	.75	.2	.3	.15	.9
29	.3	.....	.4	.4	.55	.1	1.15	.65	.2	.25	.15	1.1
30	.25	.....	.5	.4	.65	.5	1.05	.65	.2	.25	.15	.85
31	.2	.....	.5	.....	.45	.....	.6	.6	.....	.25	.....	.7

REDDIE RIVER AT NORTH WILKESBORO, N. C.

Reddie River rises on the east slope of the Blue Ridge, in western Wilkes County, N. C., flows southeastward, and unites with the Yadkin at Wilkesboro.

The station was established as a bench-mark station April 18, 1904, by B. S. Drane. It is located at the highway bridge just outside the town of North Wilkesboro, about one-half mile above the mouth of Reddie River.

The channel is straight for about 500 feet above and below the station. The current is swift. Both banks are high and not subject to overflow. The bed of the stream is composed of sand and is somewhat shifting. There is only one channel for all stages. A small lumber mill and dam a short distance above the station will affect the flow during low water.

Discharge measurements are made from the downstream side of the single-span covered bridge, the meter being lowered outside the floor. The initial point for soundings is the left end of the bottom rail, downstream hand rail.

The bench mark is the upper edge of the lower rail of the downstream guard rail, by the side of a notch, 66 feet from the initial point for soundings. Its elevation is 27.00 feet above gage datum.

Discharge measurements at this station are given in Water-Supply Paper No. 126, p. 116.

Discharge measurements of Reddie River at North Wilkesboro, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
January 4	B. S. Drane	64	57	1.44	2.40	82
August 23	do	66	132	1.97	2.73	261

MULBERRY RIVER NEAR NORTH WILKESBORO, N. C.

Mulberry River rises on the eastern slope of the Blue Ridge Mountains in northwestern Wilkes County, N. C., and flows southeastward into the Yadkin.

The station was established as a bench-mark station November 7, 1903, by B. S. Drane. It is located at the Southern Railway bridge about 2 miles east of North Wilkesboro and less than one-half mile above the mouth of Mulberry River.

The channel is curved for 100 feet above and below the station. The current is swift. The right bank approach is over a long trestle, and the stream overflows under this during high stages. The left bank is rocky, and the section is bounded by the masonry abutment of the railroad fill. The bed of the stream is rocky along the left bank and sandy along the right bank, and is permanent. There is but one channel. The current is broken at all but the lowest stages by one or more of the trestle bents supporting the bridge. High water in Yadkin River will probably back up to this point.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the streamward face of the left trestle bent.

The bench mark is the apex of the triangular downstream end of the iron bearing through which pass the iron tension rods midway between the ends of the truss, on the downstream side of the bridge, about 2 feet east of the second bent from the left bank. Its elevation is 24.00 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey: Description: 126, p. 116. Discharge: 98, p. 38; 126, p. 116.

Discharge measurements of Mulberry River near North Wilkesboro, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
January 4	B. S. Drane	22	24	1.17	0.89	28
April 26	do	19	31	1.97	1.22	61

ROARING RIVER AT ROARING RIVER, N. C.

Roaring River rises in the extreme northern part of Wilkes County, N. C., and flows south, east, and south into the Yadkin.

The station was established as a bench-mark station April 20, 1904, by B. S. Drane. It is located at the Southern Railway bridge a short distance above the mouth of Roaring River, at the town of Roaring River.

The channel is straight for about 200 feet above and 500 feet below the station. The current is swift. The banks rise gradually, but all water passes beneath the bridge and its approaches. The bed of the stream is composed of sand and gravel and is slightly shifting. There is but one channel at all stages, broken during high water by the piers and trestle approaches of the bridge. High water in Yadkin River will make this site of no value as a

gaging station, but it is good at ordinary stages. The bridge crosses the river almost at right angles to the current.

Discharge measurements are made from the downstream side of the one-span bridge. The initial point for soundings is on the downstream guard rail, exactly over the left end of the bridge.

The bench mark is the edge of the outermost eyebar of the downstream lower chord, at a point midway between the ends of the bridge opposite the iron tension rods. Its elevation is 27.00 feet above gage datum.

Discharge measurements at this station are given in Water-Supply Paper No. 126, p. 117.

Discharge measurements of Roaring River at Roaring River, N. C. in 1905

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
January 4	B. S. Drane	70	78	1.02	1.22	73
April 26	do	71	102	1.10	1.62	113
August 23	do	80	129	1.64	2.35	211

MITCHELL RIVER AT BURCH, N. C.

Mitchell River rises in the northeastern part of Alleghany County, N. C., and flows southeastward into the Yadkin.

The station was established as a bench-mark station April 20, 1904, by B. S. Drane. It is located at the Southern Railway bridge at Burch, a few hundred feet above the mouth of Mitchell River.

The channel is straight for about 700 feet above and 300 feet below the station. Both banks are high, clean, and not liable to overflow. The bed of the stream is composed of sand and gravel, and is slightly shifting. There is but one channel at all stages. Good measurements can be made at ordinary stages, but high water in Yadkin River renders the station of no value as a gaging point. The bridge crosses the stream diagonally.

Discharge measurements are made from the downstream side of the one-span railway bridge. The initial point for soundings is the end of the downstream guard rail at the left end of the bridge.

The bench mark is the upper edge of the outermost eyebar of the lower chord, downstream side, midway between the ends of the bridge, 62.5 feet from the initial point for soundings. Its elevation is 27 feet above gage datum.

Discharge measurements at this station are given in Water-Supply Paper No. 126, p. 118.

Discharge measurement of Mitchell River at Burch, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 27	B. S. Drane	85	206	0.60	2.33	125

ARARAT RIVER NEAR SILOAM, N. C.

Ararat River rises in southwestern Patrick County, Va., flows southward, and empties into the Yadkin near Siloam, N. C.

The station was established as a bench-mark station April 21, 1904, by B. S. Drane. It is located at the Southern Railway bridge, about 1 mile east of Siloam and a short distance above the mouth of the river.

The channel is straight for about 500 feet above and 150 feet below the station. The current is swift. Both banks slope gradually. All water passes beneath the bridge and approaches. The bed of the stream is composed of sand, is free from vegetation, and is somewhat shifting. There is but one channel at all stages. Flood stages will flow around the cribwork pier on each bank, supporting the ends of the iron bridge. High water in Yadkin River will make this site valueless as a gaging station, but it is a good point for low-water measurements. The bridge crosses the stream almost at right angles.

Discharge measurements are made from the downstream side of the single-span bridge, which has a short trestle approach at each end. The initial point for soundings is a point on the downstream guard rail at the left end of the truss.

The bench mark is the surface of the outer eyebar of the lower chord of the bridge, downstream side, exactly midway between the ends of the bridge, just outside the iron tension rods. Its elevation is 28.00 feet above gage datum.

Discharge data for this station are given in Water-Supply Paper No. 126, p. 119.

Discharge measurements of Ararat River near Siloam, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
January 5	B. S. Drane	110	224	0.93	0.85	209
August 24	do	129	269	2.25	2.38	604

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, 178.

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UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

MARCH, 1906.

O

Water-Supply and Irrigation Paper No. 168 Series P, Hydrographic Progress Reports, 44

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART IV.—Santee, Savannah, Ogeechee, and Altamaha Rivers and Eastern Gulf of Mexico Drainages

BY

M. R. HALL and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART IV.

By M. R. Hall and John C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Stat. L., vol. 28, p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

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1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. There is also collected information concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely upon the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain informa-

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tion concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and, in connection with short series of measurements, serve as a basis for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. "The report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware River drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin River drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and Eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay, and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based upon the observations, and such other information as may have a direct bearing on the subject of study, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor Northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor Southern Atlantic.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor Eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor Western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountain.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharge," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-foot. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream one foot wide, one foot deep, at a rate of one foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice one inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of one foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet or approximately two acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the area of cross section, the mean velocity, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the two remaining columns, which are defined on page 9, are based.

In the computations for the tables of this report the following general and special rules have been used:

FUNDAMENTAL RULES FOR COMPUTATION.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it out without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

SPECIAL RULES FOR COMPUTATION.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; 0.125; 0.012; 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equals 15 United States gallons per second.
100 California miner's inches equals 77 Colorado miner's inches.
100 California miner's inches for one day equals 4 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 130 California miner's inches.
100 Colorado miner's inches for one day equals 5.2 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.44 acre-feet.
1 million United States gallons per day equals 1.55 second-feet.
1 million United States gallons equals 3.07 acre-feet.
1 million cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.

1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; 1 ton per square foot; 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepower equal about 1 kilowatt.
To calculate water power quickly: $\frac{\text{Sec.-ft. x fall in feet}}{11}$ =Net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:
Scale 1:125000, 1 mile=0.50688 inch.
Scale 1:90000, 1 mile=0.70400 inch.
Scale 1:62500, 1 mile=1.01376 inches.
Scale 1:45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow, special methods are necessary for each class. The data upon which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n, which appears therein. The results obtained by the slope method are, in general, only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be

used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining the flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$ or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured,

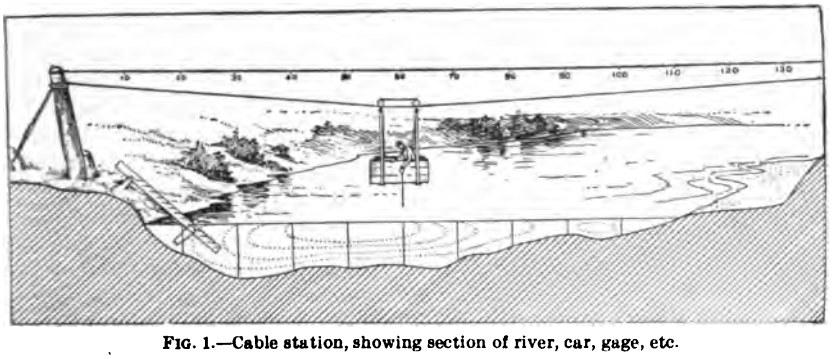

FIG. 1.—Cable station, showing section of river, car, gage, etc.

either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions, and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as equipment. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general tpyes: Those in which the wheel is made up of a series of cups, as the Price, and those having a screw propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, a cable, a boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters: multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, 4 times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard [illegible] ain at high stages.

In computing the d[illegible] ıeasurements from the observed velocities and depths at various points of measu[illegible]ment, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total dischaıge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–48.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

For stations of streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads, and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing, and a thorough knowledge of the conditions at and in the vicinity of the station.

The construction of the rating table depends upon the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant. (2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the

development of these curves there should be therefore a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity curve depends chiefly up[illegible] surface slope, the roughness of the bed, and the cross section of the stream. Of these [illegible] is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

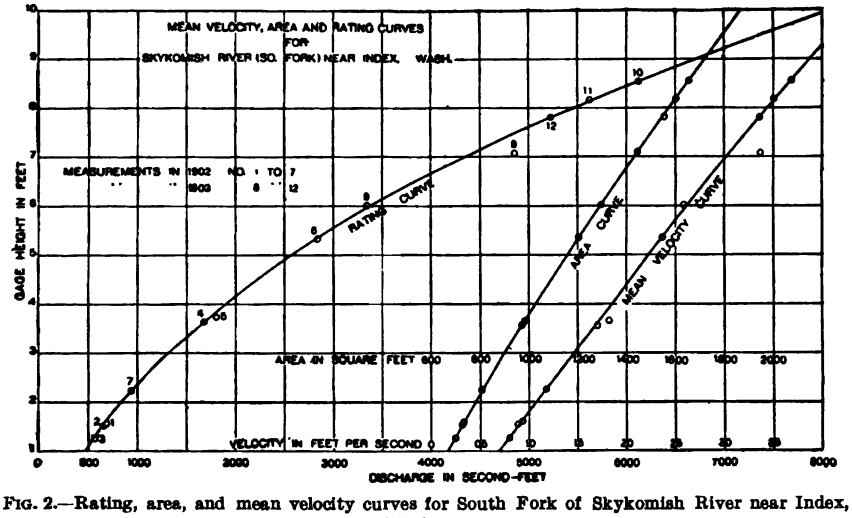

FIG. 2.—Rating, area, and mean velocity curves for South Fork of Skykomish River near Index, Wash.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximates. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are

taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharge for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, p. 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgement is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report.

Alabama.—District Hydrographer M. R. Hall,[a] assisted by J. M. Giles, W. E. Hall, B. S. Drane, and F. A. Murray. Dr. E. A. Smith, State geologist, has paid the salaries of river observers at Beck, Pera Sturdevant, Jenifer, Riverside, Elk, and Centerville. Gage heights were furnished by the Corps of Engineers, U. S. Army, for Palos and Tuscaloosa, and by the United States Weather Bureau observer. F. P. Chaffee, for Selma.

Georgia.—District Hydrographer M. R. Hall, assisted by J. M. Giles, W. E. Hall, B. S. Drane, F. A. Murray, A. T. Mitchelson, and O. P. Hall. Prof. W. S. Yeates, State geologist, has paid the salaries of river observers at Tallulah Falls, Groveland, Davisboro, Reidsville, Greensboro, Buckhead, Floville, Norcross, Demorest, Freemans, Canton (part of year), Carters, and Cartecay. J. M. Youngblood has furnished, without cost, gage heights for Augusta. The following United States Weather Bureau officials have furnished gage heights for the United States Weather Bureau stations, as noted in the description of stations: D. Fisher, Augusta, Ga.; J. B. Marbury, Atlanta, Ga.; and M. B. Summers, Macon, Ga. Transportation has been furnished by J. S. B. Thompson, general agent of the Southern Railway; by Thomas K. Scott, general manager of the Georgia Railroad; by James T. Wright, vice-president and general manager of the Macon, Dublin and Savannah Railroad; by W. L. Mapother, first vice-president of the Louisville and Nashville Railroad. The above transportation was not confined to the State of Georgia, but was also furnished for the States of South Carolina, Alabama, Mississippi, and Tennessee.

Mississippi.—District Hydrographer M. R. Hall, assisted by J. M. Giles and W. E. Hall. Gage heights were furnished by the United States Weather Bureau officials for the stations at Yazoo City.

North Carolina.—District hydrographer, M. R. Hall, assisted by W. E. Hall and B. S. Drane. Dr. C. A. Schenck, director of the Biltmore School of Forestry, paid the gage readers at Davidsons River, Sitton, and Pinkbed.

South Carolina.—District Hydrographer M. R. Hall, assisted by J. M. Giles, B. S. Drane, A. T. Mitchelson, and F. A. Murray.

SANTEE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Santee River is formed in the central part of South Carolina by the junction of Congaree and Wateree rivers, flows southeastward, and enters the Atlantic Ocean about 10 miles north of Cape Roumain. It has a total length of about 180 miles (following the course of the river) and drains an area of about 15,000 square miles. It is a navigable stream for its entire length, and of course offers no opportunities for the development of power.

Wateree River, the more northerly of the two parent streams, rises on the eastern slope of the Blue Ridge, in McDowell County, N. C., and flows northeastward and then eastward, then bends abruptly to the southeast and flows in this general direction across the south central part of North Carolina and the north central part of South Carolina to its junction with the Congaree, practically paralleling the course of Yadkin and Pedee rivers. This stream, throughout its course in North Carolina and also through that part of its course in South Carolina above the mouth of Wateree Creek, is known as Catawba River. The

[a] Office of the district hydrographer for South Atlantic States and eastern Gulf of Mexico, 209 Temple court, Atlanta, Ga.

total length of the stream is about 270 miles in a straight line, and about 450 miles when all the windings are followed.

The Wateree is navigable as far as Camden, but above that point the fall is so great that navigation is impracticable. In 1826 and following years the State of South Carolina spent large sums in the attempt to render the river navigable by means of locks and dams. Some large and important works were constructed at great expense, but the undertaking was abandoned before their completion.

The drainage basin resembles that of the Yadkin in many respects, the upper portion of the stream flowing between parallel ranges of mountains, from which it receives many tributaries, affording much power. The average width of the valley of the main stream in North Carolina is only from 15 to 20 miles, and the fall in the main stream is considerable. The greater part of the drainage basin is hilly, and the upper portions are mountainous. A number of the tributary streams rise and flow for almost their entire course in high mountains. About 65 per cent of the upper part of the basin is in forest. Linville and John rivers, the principal tributaries in North Carolina, flow in country of this character, and their basins are almost entirely forested.

Wateree River crosses the fall line about 5 miles above Camden, S. C., in rapids about 5 miles in length, with a total fall of about 52 feet. The Great Falls of the Catawba are some distance above. This is the largest power in South Carolina and one of the largest in the Southern States, the available fall being 173 feet.

The average rainfall in the basin is about 50 inches, the annual total increasing as the stream is ascended. The greatest flood ever experienced on the river was in May, 1901, the gage reading at the Rockhill station being 24.15 feet and the measured discharge nearly 151,000 second-feet, or nearly 50 second-feet per square mile from the drainage basin above the station. The greatest flood previously experienced on the stream was in 1865. This was only 2 feet lower than the flood of May, 1901, on the lower part of the river, but the latter rise exceeded all previous records on the upper part of the river by from 8 to 15 feet.

The minimum flow recorded for the Rockhill station is 1,300 second-feet, or about 0.43 second-foot per square mile. This occurred in September, 1895 and 1896. The maximum flow is about 116 times the minimum. During 1904 the minimum flow was 810 second-feet at the Catawba station. This was due to the storing of water at the new dam near Rockhill.

The Congaree, the second and more southerly of the two streams which by their union form the Santee, is formed by the junction of Broad and Saluda rivers between Lexington and Richland counties, S. C., whence it flows in a general southeasterly direction, but in a very tortuous channel, for about 60 miles to its junction with the Wateree. The stream is navigable to Columbia, the capital of the State. There it crosses the fall line, giving rise to a very fine water power, the only one on the stream, which is being extensively used in the manufacturing enterprises of Columbia.

Broad River rises on the eastern slope of the Blue Ridge near Hickory Nut Gap, in the southwestern part of McDowell County and the northeastern part of Henderson County, N. C., and flows in a general southeasterly direction across a portion of south-central North Carolina and north-central South Carolina to its junction with the Saluda at Columbia. The length of the river in a straight line is about 128 miles, but it is much greater if the course of the river is followed.

In general character the drainage basin closely resembles those of the Yadkin and the Catawba. It lies entirely above the fall line, is without lakes, and is well wooded, especially in the upper portion, and the soil is generally loose and porous.

The rainfall of the basin averages about 51 inches, of which about 13 inches fall in spring, the same in summer, about 10 in autumn, and about 15 in winter. It is probable that the precipitation in the region about the headwaters is much greater than these amounts indicate.

The maximum flood recorded at the Alston station on this stream, 25 miles above Columbia, occurred in May, 1901, the estimated discharge being 131,000 second-feet, equivalent

to about 28 second-feet per square mile. The minimum flow recorded at the same place is 1,250 second-feet, equivalent to 0.27 second-foot per square mile. This occurred during October, 1904. The maximum flow is therefore about 105 times the minimum.

Saluda River is formed in western South Carolina by the junction of North, South, and Middle forks, and flows southeastward to its junction with Broad River, the length of the stream being about 110 miles in a straight line. The three forks are mountain streams, and the character of the drainage basin is similar to that of Broad River.

The average rainfall over the basin of the stream is 51 inches, the amount and seasonal distribution being similar to that on the Broad. The maximum flood recorded at the Waterloo station on this stream occurred in February, 1902, the rise being 23 feet above low water and the estimated discharge being about 18,500 second-feet, equivalent to about 18 second-feet per square mile. The minimum discharge so far recorded is 200 second-feet, or about 0.19 second-foot per square mile. This occurred during October, 1904. The maximum discharge is therefore about 108 times the minimum.

The following pages give the results of the data collected in this drainage during 1905:

CATAWBA RIVER NEAR CATAWBA, S. C.

This station was established in order to continue the records on Catawba River after the Rockhill station had been abandoned. No very favorable section was found, but this one was selected as the most available one, and a temporary gage was put in September 11, 1903, by J. M. Giles. The station is located at the bridge of the Southern Railway 2 miles southeast of Catawba, S. C., and about 2 miles below the crossing of the Seaboard Air Line.

The channel is straight above and below the bridge. At ordinary stages the river is about 490 feet wide; at high stages the banks, which are rather high, will overflow to some extent, but all water will pass under the bridge and its approaches. The bed is partly rock and will probably shift little. The current is sluggish at low water—rather too much so for accurate work.

Discharge measurements are made from a plank footway on the lower members of the bridge. The initial point for soundings is the river edge of the capstone on the left bank pier. The bridge is a three-span deck bridge about 520 feet long, with 250 feet of trestle approach on the right bank and 160 feet on the left bank. The bridge is not quite at right angles with the current and corrections are made to the widths in computing measurements.

The gage is a vertical timber, reading from zero to 12 feet, driven into the bed of the river and spiked to a willow tree. It is located on the left bank of the river, about 85 feet above the bridge. A second section of the gage is attached to a tree on the bank of a small branch about 200 feet from the river and the same distance above the bridge. This section extends from 12 to 27 feet. The gage is read twice each day by J.Y. Brice. Bench marks were established as follows: (1) The top of the joint plate on the upstream bottom chord at a point 44 feet from the initial point, elevation, 31.70 feet. (2) A standard copper plug set in a solid rock projecting from water in river about 200 feet above the bridge and opposite point 240 feet from initial point; elevation, 5.73 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 64; WS 15, p 34; 27, p 27; 36, pp 120-121; 48, p 143; 65, p 247; 83, pp 73-74; 98, p 42; 127, p 20.

Discharge: Ann 18, iv, p 64; WS 15, p 34; 27, p 44; 36, p 121; 48, p 143; 65, p 247; 98, p 42; 127, p 20.

Discharge, minimum: WS 36, p 122.

Discharge, monthly: Ann 18, iv, p 65; 19, iv, p 212; 20, iv, p 149; 21, iv, p 123; WS 75, p 58; 127, p 22.

Discharge, yearly: Ann 20, iv, p 50.

Gage heights: WS 11, p 18; 15, p 34; 27, p 37; 36, p 121; 48, p 144; 65, p 248; 83, p 74; 98, p 43; 127, p 21.

Hydrographs: Ann 19, iv, p 213; 20, iv, p 149; 21, iv, p 123.

Rating tables: Ann 18, iv, p 65; 19, iv, p 212; WS 27, p 45; 39, p 443; 65, p 320; 127, p 22.

Discharge measurements of Catawba River near Catawba, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 14	J. M. Giles	475	5,721	2.88	7.95	16,460
January 16	do	456	3,916	1.46	4.15	5,731
March 13	do	444	3,402	1.60	3.76	5,438
May 29	B. S. Drane	470	2,965	1.42	3.06	4,221
November 15	W. E. Hall	452	2,696	.31	1.55	824

Daily gage height, in feet, of Catawba River near Catawba, S. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.5	3.7	2.55	2.65	2.65	2.05	3.0	2.4	1.8	2.1	2.2
2	2.65	2.45	3.4	2.5	2.45	2.45	2.0	2.7	2.3	1.75	2.15	2.3
3	2.45	2.35	3.3	2.65	2.4	2.4	3.15	2.45	2.55	2.05	2.25	2.75
4	2.5	2.3	3.2	2.5	4.6	2.25	2.85	2.25	3.15	2.1	2.15	4.7
5	2.45	2.3	3.1	2.45	3.35	2.45	2.7	2.95	2.7	2.1	1.55	4.6
6	2.4	2.55	3.2	3.15	3.45	2.25	6.0	4.4	2.7	2.1	1.75	3.2
7	3.5	2.35	3.0	3.25	4.3	2.1	5.8	3.05	2.45	1.95	2.05	2.55
8	3.8	2.7	3.1	3.05	5.4	2.15	3.8	3.45	2.25	1.7	2.1	2.4
9	3.7	3.5	2.9	2.85	4.4	2.2	2.8	6.1	2.2	1.95	2.05	2.4
10	3.1	3.9	3.1	2.85	3.7	2.1	2.7	6.8	2.2	2.05	2.1	4.8
11	2.85	4.5	3.0	2.75	3.45	1.95	3.05	13.4	2.35	2.15	2.1	6.3
12	3.2	5.0	3.4	2.8	3.55	2.2	5.0	11.9	2.3	2.1	1.5	4.2
13	6.1	7.4	3.8	2.7	3.95	2.25	11.6	9.7	2.35	3.15	1.8	3.3
14	8.1	7.7	3.3	3.1	5.2	2.1	17.3	6.6	2.0	2.7	2.05	2.95
15	5.4	5.5	3.2	3.25	5.7	2.0	14.2	5.4	2.1	2.05	2.05	2.95
16	4.2	3.8	3.0	3.15	6.4	2.1	8.8	4.8	2.0	2.45	2.1	3.45
17	3.3	3.4	2.9	3.1	5.6	2.1	5.4	4.4	2.0	2.1	2.15	3.4
18	3.2	3.2	2.8	2.85	5.2	2.1	4.2	3.8	2.55	2.1	2.2	3.45
19	3.0	3.2	2.75	2.65	4.1	3.9	3.7	3.35	2.55	2.15	1.50	2.9
20	3.0	3.7	2.85	2.6	3.45	4.1	3.5	3.05	2.15	2.25	1.85	2.95
21	3.0	11.9	2.7	2.55	3.05	3.7	3.3	3.1	2.0	2.2	2.3	12.4
22	2.75	11.2	2.7	2.5	3.1	2.9	3.25	4.8	2.35	1.55	2.3	13.2
23	2.85	8.2	2.75	2.45	3.45	2.55	3.55	3.4	2.0	1.75	2.25	7.2
24	2.65	7.0	2.85	2.5	3.55	2.3	3.6	3.9	1.9	2.05	2.2	4.8
25	2.6	5.8	2.65	2.45	3.05	2.5	3.05	4.2	2.25	2.15	2.15	3.95
26	2.45	4.7	2.75	2.45	2.9	2.85	2.95	6.2	2.0	2.3	1.55	3.55
27	2.1	4.4	2.85	2.55	3.0	2.35	2.7	3.85	2.0	2.25	1.75	3.4
28	2.05	4.0	2.65	2.5	2.9	2.2	2.65	3.2	2.1	2.2	2.2	3.6
29	2.4	.....	2.65	2.5	3.1	2.05	5.0	2.8	2.0	1.6	2.15	3.95
30	2.7	.....	2.55	2.4	2.75	1.9	4.1	2.6	2.0	1.9	2.05	3.65
31	2.6	.....	2.5	.....	2.65	.....	3.85	2.5	.....	2.15	.....	3.15

CATAWBA RIVER NEAR MORGANTON, N. C.

The original station was established June 19, 1900, in connection with the hydrographic investigation of the southern Appalachian area, at which time a wire gage was installed on the highway bridge on the road from Morganton to Hartland. In May, 1901, the river throughout this part of its course rose from 8 to 15 feet higher than ever before known, and the bridge and gage were destroyed. The present station was established May 15, 1903, by E. W. Myers, at the bridge which was built to replace the one carried away by the flood of May, 1901. The station is 1 mile north of Morganton and about 200 yards below the mouth of Upper Creek.

The channel is straight for about 200 feet above and 600 feet below the station. The current is swift. The right bank is low and overflows to a slight extent on account of erosion, but all water passes beneath the approach to the bridge. The left bank is high, rocky, and wooded. The bed of the stream is rocky, with sand and gravel near the right bank.

Discharge measurements are made from the downstream side of the single-span steel highway bridge. The initial point for soundings is the left end of the downstream hand rail.

A standard chain gage is attached to the lower chord on the downstream side of the bridge; length of chain, 37.60 feet. The gage is read once each day by Hort Edmunson. Bench marks were established as follows: (1) The left side of the upper surface of the sixth floor beam at the downstream side of the bridge, marked by a spot of white paint and the letters "B. M.;" elevation, 34.77 feet. (2) A copper plug set in cement in a rock on the left bank 24.3 feet back of the initial point for soundings, 3 feet downstream from the line of the downstream truss. It is about 1½ feet above the road and is inclosed in a circle of white paint and marked "B. M.;" elevation, 37.37 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 140–141; 65, p 247; 83, p 75; 98, pp 45–46; 127, p 23.
Discharge: 48, p 141; 65, p 247; 83, p 75; 98, p 46; 127, p 24.
Discharge, monthly: 83, p 77; 98, p 47; 127, p 26.
Gage heights: 48, p 141; 83, pp 75–76; 98, pp 46–47; 127, p 25.
Rainfall data: 83, p 77.
Rating tables: 83, p 76; 98, p 47; 127, p 25.

Discharge measurements of Catawba River near Morganton, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 19	B. S. Drane	170	482	1.72	1.51	827
June 27	do	139	419	1.76	1.35	738
August 25	do	171	630	2.43	2.01	1,529
November 9	W. E. Hall	165	460	1.08	1.09	498

Daily gage height, in feet, of Catawba River near Morganton, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.45	1.3	2.05	.....	1.35	1.5	1.7	1.55	1.45	1.1	.....	1.1
2	1.4	1.25	1.00	.....	1.35	1.45	1.6	1.55	1.95	1.05	.....	1.1
3	1.4	1.3	1.9	.....	1.5	1.4	1.65	1.5	1.8	1.15	.....	4.3
4	1.3	1.2	1.85	.....	1.7	1.4	1.7	1.5	1.65	1.15	.....	2.0
5	1.25	1.25	1.85	.....	1.65	1.35	1.95	1.45	1.45	1.15	.....	1.85
6	1.75	1.3	1.8	.....	3.3	1.35	3.3	1.55	1.4	1.1	.....	1.45
7	2.2	1.45	1.75	.....	2.6	1.3	2.3	1.45	1.35	1.15	1.1	1.4
8	1.55	1.45	1.65	.....	2.25	1.25	2.0	2.0	1.3	1.15	1.1	1.3
9	1.45	1.4	1.8	1.75	2.4	1.25	2.95	2.7	1.3	1.1	1.1	4.8
10	1.85	1.3	2.2	1.7	2.5	1.2	1.95	4.1	1.3	3.4	1.1	2.6
11	2.3	1.6	2.25	1.65	2.25	1.15	3.2	6.2	1.25	1.65	1.1	1.9
12	7.2	2.1	2.1	1.75	2.2	1.15	11.5	4.2	1.35	1.55	1.1	1.75
13	3.8	2.6	2.00	2.05	1.95	1.1	8.2	4.0	1.3	1.4	1.1	1.7
14	2.65	1.7	1.9	2.00	4.5	1.15	6.2	3.5	1.25	1.35	1.15	1.6
15	2.1	1.7	1.65	1.85	4.6	1.6	4.0	3.6	1.25	1.35	1.1	1.95
16	1.95	1.6	1.6	1.7	4.8	2.3	3.4	2.9	1.25	1.25	1.1	2.35
17	1.7	1.55	1.7	1.65	3.2	5.6	2.6	2.5	1.25	1.2	1.1	2.1
18	1.6	1.5	1.6	1.65	2.7	4.7	2.4	2.3	1.3	1.2	1.05	1.95
19	1.55	1.45	1.6	1.5	2.45	3.2	2.25	2.2	1.3	1.2	1.05	1.85
20	1.5	2.3	1.55	1.45	2.0	2.6	2.15	2.1	1.25	1.2	1.2	1.7
21	1.5	3.7	1.5	1.4	2.05	2.25	2.1	2.0	1.3	1.15	1.2	4.8
22	1.45	3.8	1.55	1.45	2.0	1.9	2.6	2.0	1.2	1.1	1.15	2.8
23	1.4	3.6	1.6	1.45	1.95	1.85	2.45	1.8	1.2	1.05	1.1	3.3
24	1.35	2.9	1.5	1.4	3.3	1.7	2.4	2.0	1.2	1.15	1.1	2.05
25	1.3	2.6	.....	1.4	2.55	1.55	2.3	2.25	1.2	1.25	1.1	1.95
26	1.2	2.4	.....	1.45	2.15	1.5	2.15	1.9	1.15	1.20	1.1	1.9
27	1.15	2.2	.....	1.5	1.95	1.35	2.1	1.75	1.15	.....	1.05	1.8
28	1.15	2.1	.....	1.5	1.9	1.35	1.95	1.6	1.15	.....	1.1	1.6
29	1.1	.....	.....	1.45	1.85	1.65	2.00	1.55	1.15	.....	1.1	1.6
30	1.35	.....	.....	1.4	1.75	1.8	1.85	1.5	1.1	.....	1.1	1.75
31	1.3	.....	.....	.....	1.65	.....	1.6	1.4	.....	.....	.....	1.6

Station rating table for Catawba River near Morganton, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	400	1.40	740	1.80	1,200	2.10	1,655
1.10	470	1.50	840	1.90	1,340	2.20	1,835
1.20	550	1.60	950	2.00	1,490	2.30	2,025
1.30	640	1.70	1,070				

The above table is based on discharge measurements made during 1903-1905. It is well defined between gage heights 1 foot and 2.7 feet. The table has been extended beyond these limits. Above gage height 2.3 feet the rating curve is a tangent, the difference being 195 per tenth. Above gage height 2.2 feet the table is the same as for 1904.

Estimated monthly discharge of Catawba River near Morganton, N. C., for 1905.

[Drainage area, 758 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	11,580	470	1,438	1.90	2.19
February	4,950	550	1,616	2.13	2.22
March 1-24	1,930	840	1,212	1.60	1.43
April 9-30	1,572	740	964	1.27	1.04
May	6,900	690	2,311	3.05	3.52
June	8,460	470	1,474	1.94	2.16
July	19,960	950	3,290	4.34	5.00
August	9,630	740	2,259	2.98	3.44
September	1,415	470	670	.884	.986
October 1-26	4,170	435	710	.937	.906
November 7-30	550	435	476	.628	.561
December	6,900	470	1,875	2.47	2.85

JOHN RIVER NEAR MORGANTON, N. C.

This station was established for the purpose of making a series of miscellaneous measurements. It is located at the iron highway bridge on the Lenoir road, about 3 miles from Morganton, N. C.

The channel is curved for about 300 feet above and straight for 500 feet below the station. The current is swift. Both banks are high, wooded, and not liable to overflow. The bed of the stream is rocky along the left bank, which is composed of rock, and sandy along the right bank. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the single-span bridge. The initial point for soundings is the left end of the main span, downstream side, over the middle of the left pier.

Gage heights are determined directly from the bench mark, which is the upper edge of the end of a bar extending from the floor beam to a brace at the downstream end of the second floor beam from the left pier, 32 feet from the initial point for soundings; elevation, 30.00 feet above the datum of the assumed gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, pp 142-143; 65, p 247; 83, p 77; 127, p 26.
Discharge: 48, p 143; 65, p 247; 83, p 77; 98, p 55; 127, p 27.
Discharge, monthly: 83, p 80.
Gage heights: 48, p 143; 65, p 247; 83, pp 78-79.
Rainfall data: 83, p 80.
Rating table: 83, p 79.

Discharge measurements of John River near Morganton, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 19	B. S. Drane	64	178	1.60	1.66	284
June 27	do	63	173	1.38	1.62	239
August 25	do	64	207	2.26	2.0	468
November 9	W. E. Hall	60	127	1.12	1.28	142

WATEREE RIVER NEAR CAMDEN, S. C.

Camden, S. C., is on Wateree River, 45 miles above its mouth and about 5 miles below the fall line. A station has been maintained by the United States Weather Bureau since 1891 at the toll bridge about 2 miles west of Camden.

The channel is 270 feet wide at low water, and is broken by one pier. The current is smooth and moderately swift, except at lowest stages. Both banks are high, but are liable to overflow at time of floods. Both are open and cultivated, except along the edge, where there are trees. The bed is sand and is slightly changeable. The river below has a very small slope, which is unfavorable for good rating at high stages, as the position of the flood crest will affect the slope largely.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the right-bank abutment. The bridge consists of two spans, about 180 feet each, supported by tubular iron piers, and has short wooden approaches with brick abutments on both banks.

The Weather Bureau gage is in three sections. Only the third section, reading from 15 to 32 feet, painted on the upstream cylindrical pier on the right bank, is in good condition. August 12, 1904, a standard chain gage was fastened to a short vertical timber resting on the end of a floor beam 40 feet from the right-bank pier and fastened to the double rod hanger; length of chain, 43.53 feet. The datum is the same as that of the upper section of the Weather Bureau gage. The bottom of the box is about 3 feet above the bridge floor, and is 41.53 feet above the gage datum. Gage heights are furnished by the United States Weather Bureau. Bench marks were established as follows: (1) The top of the upstream end of the floor beam 40 feet from right-bank pier, at a point directly under the gage; elevation, 36.85 feet. (2) Two large wire nails driven horizontally into a sycamore tree on right bank of river and upstream side of the road, 110 feet from the pier; elevation, 31.27 feet. (3) The top of a 2-inch capped pipe post, set about 3 feet into the ground and provided with a cross at the bottom to make it permanent; it is located on the right bank, about 100 feet to the right of the first iron pier and 15 feet upstream from the line of the upper edge of the bridge; elevation, 33.10. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 36, p 123; 98, pp 40-41; 127, pp 27-28.
Discharge: 98, pp 41, 54; 127, p 28.
Gage heights: 98, p 41; 127, p 28.

Discharge measurements of Wateree River near Camden, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	J. M. Giles	286	3,455	1.52	7.80	5,275
March 14	do	299	4,488	1.83	11.07	8,243
May 27	B. S. Drane	300	4,328	1.86	10.64	8,059
May 27	do	300	4,429	1.92	10.90	8,524
June 26	A. T. Mitchelson	275	2,735	1.05	5.09	2,873
June 26	do	275	2,816	1.10	5.24	3,107
October 19	F. A. Murray	272	2,346	0.73	4.33	1,708

Daily gage height, in feet, of Wateree River near Camden, S. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.1	5.0	9.9	5.3	5.5	6.3	4.0	8.6	6.3	4.4	4.5	3.9
2	5.4	4.8	9.1	5.4	5.8	5.8	3.8	6.9	6.2	4.1	4.4	4.3
3	5.4	4.7	8.5	5.6	5.5	5.3	4.2	6.1	6.4	3.6	4.8	9.6
4	5.0	4.7	8.2	5.8	8.8	5.0	6.6	5.6	6.9	4.9	4.6	10.9
5	4.9	4.6	8.0	6.4	11.5	4.8	6.4	5.4	7.7	4.3	4.5	12.8
6	4.8	4.4	7.5	7.0	8.1	5.0	5.8	8.8	6.9	4.8	3.8	10.4
7	6.1	5.2	7.6	8.2	8.8	4.8	17.1	9.2	6.8	4.8	[a] 2.85	7.4
8	9.3	5.4	7.3	7.6	11.6	4.5	12.2	8.4	6.4	4.4	4.2	5.1
9	8.4	8.7	7.2	7.0	12.2	4.4	7.7	20.3	6.3	3.9	4.4	5.55
10	8.2	14.5	7.8	6.2	9.9	4.4	5.6	23.7	5.6	3.8	4.0	8.7
11	6.7	15.1	7.7	6.6	11.1	4.1	5.4	25.0	5.3	4.8	4.8	13.7
12	6.0	14.6	8.8	6.4	9.6	4.0	7.0	28.5	5.8	4.8	4.4	13.8
13	8.5	20.5	10.8	9.3	11.2	4.5	16.8	27.8	6.3	4.6	3.8	10.2
14	18.1	25.3	10.8	9.2	11.8	4.8	27.0	24.8	6.7	7.6	[a] 2.9	7.9
15	18.5	22.9	9.6	8.2	13.1	4.8	29.4	19.6	6.2	5.6	4.0	8.2
16	12.0	16.5	8.8	8.2	13.8	4.6	26.8	15.6	5.2	4.8	4.0	8.6
17	9.4	11.1	7.6	7.6	15.1	4.6	21.6	16.0	5.2	5.4	4.2	8.5
18	7.7	8.7	7.3	7.2	14.0	4.5	14.2	12.2	4.9	5.0	4.2	8.3
19	6.8	7.9	7.0	6.4	11.7	4.8	10.6	9.8	6.9	4.8	4.5	8.4
20	6.7	7.7	6.6	6.0	9.1	8.7	8.8	8.5	6.0	4.8	3.75	7.4
21	6.7	21.5	6.9	5.9	7.6	9.0	8.2	7.8	5.3	4.8	[a] 2.9	23.0
22	6.4	28.1	6.6	5.8	7.1	7.2	7.6	7.9	4.9	4.6	4.8	28.4
23	5.8	26.5	6.6	5.8	7.9	6.1	8.0	10.4	5.0	3.8	4.75	26.3
24	5.9	22.3	6.9	5.8	11.9	5.6	8.2	12.4	4.5	[a] 3.4	4.5	19.6
25	5.4	19.3	6.6	5.7	9.6	4.9	8.0	12.4	4.4	4.4	4.5	13.4
26	5.1	15.5	6.4	5.8	7.7	5.3	7.4	15.4	5.3	4.4	4.2	10.2
27	4.1	12.5	6.0	8.0	10.5	5.6	7.3	14.2	4.9	4.8	3.8	9.0
28	4.3	11.2	6.5	7.0	9.0	4.8	6.6	10.1	4.7	4.9	[a] 3.05	8.6
29	4.0	.....	6.0	5.8	7.4	4.7	8.0	8.3	4.4	4.8	4.35	13.0
30	4.0	.....	5.8	5.8	7.1	4.3	13.0	7.5	4.7	3.9	4.2	13.0
31	5.2	.....	5.4	.....	6.2	.....	10.7	7.0	.....	[a] 3.0	.....	9.7

[a] Extreme low gage heights probably due to storage above.

Station rating table for Wateree River near Camden, S. C., from September 11, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	890	5.00	2,800	7.40	5,005	13.00	10,420
2.90	970	5.10	2,890	7.60	5,195	13.50	10,920
3.00	1,050	5.20	2,980	7.80	5,385	14.00	11,420
3.10	1,135	5.30	3,070	8.00	5,575	14.50	11,920
3.20	1,220	5.40	3,160	8.20	5,765	15.00	12,420
3.30	1,305	5.50	3,250	8.40	5,955	15.50	12,970
3.40	1,390	5.60	3,340	8.60	6,145	16.00	13,520
3.50	1,475	5.70	3,430	8.80	6,335	17.00	14,620
3.60	1,560	5.80	3,520	9.00	6,525	18.00	15,720
3.70	1,645	5.90	3,610	9.20	6,715	19.00	16,820
3.80	1,730	6.00	3,700	9.40	6,905	20.00	17,920
3.90	1,815	6.10	3,790	9.60	7,095	21.00	19,120
4.00	1,900	6.20	3,880	9.80	7,285	22.00	20,320
4.10	1,990	6.30	3,970	10.00	7,475	23.00	21,520
4.20	2,080	6.40	4,060	10.20	7,665	24.00	22,720
4.30	2,170	6.50	4,150	10.40	7,855	25.00	23,920
4.40	2,260	6.60	4,245	10.60	8,045	26.00	25,220
4.50	2,350	6.70	4,340	10.80	8,235	27.00	26,520
4.60	2,440	6.80	4,435	11.00	8,425	28.00	27,820
4.70	2,530	6.90	4,530	11.50	8,920	29.00	29,120
4.80	2,620	7.00	4,625	12.00	9,420	30.00	30,420
4.90	2,710	7.20	4,815	12.50	9,920		

The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 4.4 feet and 11 feet. Beyond these limits it is uncertain. The high-water estimates are rough approximations.

Estimated monthly discharge of Wateree River near Camden, S. C., for 1904–5.

[Drainage area, 2,635 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 11–30	6,430	1,475	2,390	0.907	0.675
October 1–15; 23–31	2,350	1,050	1,490	.565	.504
November 1–12; 27–30	5,005	1,220	2,470	.937	.558
December	11,520	1,645	3,717	1.41	1.63
1905.					
January	16,270	1,900	4,828	1.83	2.11
February	27,950	2,260	11,100	4.21	4.38
March	8,235	3,160	5,206	1.98	2.28
April	6,810	3,070	4,358	1.65	1.84
May	12,530	3,250	7,205	2.73	3.15
June	6,525	1,900	3,025	1.15	1.28
July	29,640	1,730	8,617	3.27	3.77
August	28,470	3,160	10,880	4.13	4.76
September	5,290	2,260	3,468	1.32	1.47
October	5,195	1,050	2,429	.922	1.06
November	2,620	930	2,019	.766	.855
December	28,340	1,815	8,946	3.40	3.92
The year	29,640	930	6,007	2.28	30.88

BROAD RIVER (OF THE CAROLINAS) AT ALSTON, S. C.

This station was established July 3, 1896, by E. W. Myers at the Southern Railway bridge at Alston, S. C., about 27 miles above Columbia.

The channel is straight above the station, but the current is interrupted by a large island and passes under the bridge at an angle. Below the bridge the channel is straight for about one-half mile. Both banks are high and all water passes beneath the bridge. The bed of the stream is of sand and silt and is slightly shifting. There is but one channel at all stages, broken only by the piers of the bridge.

Discharge measurements are made from the downstream side of the six-span steel railway bridge. The initial point for soundings is the end of the second span nearest the left bank, over the center of the pier. At flood stages some water passes behind this point.

During 1905 the bridge was replaced by a new one. The standard chain gage, which had been located on the old bridge, was fastened to the outside of the guard rail of the new bridge at the third floor beam of the second span from the left bank at the original datum. The length of the chain is 39.28 feet. The gage is read twice each day by G. M. Heron. Bench marks were established as follows: (1) The right edge of the top of the downstream end of the third floor beam from the left end of the second span from the left bank; elevation, 37.91 feet. (2) A standard copper bolt set in rock on the left bank on the hillside 50 yards from the river and 52 feet downstream from the center line of the trestle approach to the bridge, 21.2 feet from the corner of the pump house; elevation, 26.59 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 67; WS 15, p 37; 27, p 28; 36, p 125; 48, p 146; 65, p 250; 83, p 82; 98, p 48; 127, pp 28-29.

Discharge: Ann 18, iv, p 68; WS 15, p 37; 27, p 44; 36, p 125; 48, p 146; 65, p 250; 83, p 82; 98, p 48; 127, p. 29.

Discharge, monthly: Ann 20, iv, p 151; 21, iv, p 128; 22, iv, p 158; WS 75, p 60; 83, p 84; 98, p 51; 127, p. 31.

Discharge, yearly: Ann 20, iv, p 50.

Gage heights: WS 11, p 18; 15, p 37; 27, p 39; 36, p 125; 48, p 147; 65, p 250; 83, p 83; 98, p 49; 127, p 30.

Hydrographs: Ann 20, iv, p 152; 21, iv, p 128; 22, iv, p 158; WS 75, p 60.

Rating tables: WS 27, p 45; 39, p 444; 52, p 512; 65, p 320; 83, p 83; 98, p 50; 127, p 30.

Discharge measurements of Broad River (of the Carolinas) at Alston, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 10	J. M. Giles	496	2,050	2.23	4.25	4,575
March 15	do	493	2,039	2.58	4.57	5,253
May 25	B. S. Drane	553	2,597	2.36	[a] 5.27	6,143
June 23	A. T. Mitchelson	493	1,880	1.80	3.58	3,398
June 24	do	500	1,662	1.92	3.59	3,205
June 24	M. R. Hall	502	1,892	1.80	3.59	3,413
September 9	W. E. Hall	473	1,837	1.53	3.11	2,687
October 18	F. A. Murray	481	1,124	1.73	2.63	1,941

[a] Gage height doubtful.

Daily gage height, in feet, of Broad River (of the Carolinas) at Alston, S. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.9	3.35	5.2	3.65	3.85	4.2	3.1	3.45	3.4	2.55	2.82	2.8
2	3.65	3.7	4.9	3.6	3.7	3.8	6.0	3.3	3.3	2.4	3.8	2.8
3	3.5	3.55	4.6	3.5	3.35	3.6	8.8	3.1	3.65	2.05	2.48	4.9
4	3.8	3.5	4.5	3.15	8.6	3.45	8.4	3.35	4.5	2.55	2.58	8.8
5	3.65	3.55	4.35	3.75	8.5	3.3	6.2	3.35	3.6	2.8	2.4	7.0
6	3.55	3.45	4.2	4.05	6.2	3.0	5.5	3.8	3.4	2.78	2.68	5.3
7	4.0	3.4	4.1	4.25	6.0	3.35	6.6	3.4	3.35	2.62	2.48	4.2
8	5.0	4.5	4.3	3.95	6.3	3.15	5.2	4.65	3.4	2.05	2.78	3.95
9	4.7	6.5	4.25	3.85	6.3	3.25	4.2	8.8	3.1	2.55	2.8	4.65
10	4.35	8.5	4.3	4.0	5.2	3.05	3.9	7.8	3.0	2.1	2.8	8.8
11	4.25	8.9	4.2	4.85	4.6	3.15	5.0	12.2	2.7	2.1	2.92	8.0
12	4.2	9.0	4.35	5.0	6.3	3.0	6.1	13.4	2.55	[a] 1.8	2.25	5.7
13	8.4	11.7	5.1	4.2	5.1	2.6	10.6	11.7	3.35	3.3	3.9	4.85
14	9.5	12.1	4.7	4.25	8.4	3.0	12.8	8.8	4.6	4.0	2.82	4.4
15	7.1	10.0	4.6	4.35	7.7	3.1	11.0	6.3	4.0	3.8	2.2	4.7
16	5.8	7.3	4.25	4.4	6.1	3.1	8.4	5.7	3.35	2.4	2.12	5.1
17	5.0	5.7	4.15	3.95	6.4	2.9	6.0	5.4	2.9	2.3	2.22	5.2
18	4.7	5.1	4.05	3.4	5.8	4.2	5.2	5.6	2.9	2.6	2.4	4.65
19	4.4	4.9	4.05	3.85	4.9	4.45	4.9	5.0	2.55	2.8	2.68	4.4
20	4.45	4.9	3.85	3.65	4.6	3.7	4.35	3.8	3.55	3.0	2.58	5.1
21	4.4	14.9	3.65	3.6	4.2	3.7	4.15	4.2	3.0	3.3	2.87	18.7
22	4.2	15.2	4.05	3.65	3.9	3.5	4.0	4.0	2.9	2.5	3.2	19.0
23	4.0	12.2	4.3	3.6	3.9	3.35	4.2	4.8	2.85	2.28	3.0	11.9
24	3.75	10.0	4.1	3.35	7.6	3.85	3.7	4.6	2.85	2.7	2.88	6.8
25	4.1	7.6	3.95	3.0	4.95	3.25	3.4	6.6	2.5	3.4	2.92	5.7
26	3.65	6.4	3.85	3.4	4.7	2.95	3.55	9.4	2.2	2.55	2.98	5.1
27	3.35	5.6	3.55	4.9	6.2	2.5	3.5	6.9	2.6	2.55	2.75	4.8
28	3.45	5.4	3.45	4.0	5.8	2.8	3.4	4.8	2.65	2.45	2.58	4.6
29	3.55	.....	3.85	3.6	5.2	2.95	5.6	3.9	2.65	2.92	2.85	6.2
30	3.7	.....	3.75	3.7	4.55	3.2	5.8	4.0	2.65	2.5	2.88	5.6
31	3.3	.....	3.7	.....	4.25	.....	4.1	3.5	.....	2.0	.....	5.0

[a] Probably due to storing water.

Station rating table for Broad River (of the Carolinas) at Alston, S. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	990	3.20	2,590	4.60	5,750	6.00	9,600
1.90	1,040	3.30	2,770	4.70	6,025	6.20	10,200
2.00	1,100	3.40	2,960	4.80	6,300	6.40	10,800
2.10	1,170	3.50	3,150	4.90	6,575	6.60	11,400
2.20	1,250	3.60	3,350	5.00	6,850	6.80	12,000
2.30	1,340	3.70	3,560	5.10	7,125	7.00	12,600
2.40	1,440	3.80	3,780	5.20	7,400	7.20	13,200
2.50	1,550	3.90	4,010	5.30	7,675	7.40	13,800
2.60	1,670	4.00	4,250	5.40	7,950	7.60	14,400
2.70	1,800	4.10	4,500	5.50	8,225	7.80	15,000
2.80	1,940	4.20	4,750	5.60	8,500	8.00	15,650
2.90	2,090	4.30	5,000	5.70	8,775	8.50	17,275
3.00	2,250	4.40	5,250	5.80	9,050	9.00	18,900
3.10	2,420	4.50	5,500	5.90	9,325	10.00	22,150

The above table is based on 29 discharge measurements made during 1901-1905. It is well defined between gage heights 3 feet and 10 feet. Above 10 feet the discharge is approximate.

Estimated monthly discharge of Broad River (of the Carolinas) at Alston, S. C., for 1905.

[Drainage area, 4,609 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	20,520	2,770	5,719	1.24	1.43
February	41,600	2,865	13,970	3.03	3.15
March	7,400	3,055	4,780	1.04	1.20
April	6,850	2,250	4,045	.878	.980
May	17,600	2,865	8,629	1.87	2.16
June	5,375	1,550	2,873	.623	.695
July	32,040	2,420	9,318	2.02	2.33
August	34,400	2,420	9,653	2.09	2.41
September	5,750	1,250	2,590	.562	.627
October	4,250	990	1,831	.397	.458
November	4,010	1,186	1,943	.422	.471
December	56,800	1,940	11,720	2.54	2.93
The year	56,800	990	6,423	1.39	18.85

GREEN RIVER NEAR FLAT ROCK, N. C.

This station was established November 13, 1905, for the purpose of making a series of miscellaneous measurements. It is located at a single 50-foot span wagon bridge, 3½ miles northeast of Flat Rock, N. C., and about the same distance downstream from the crossing of the Southern Railway.

The current is good, being fairly swift at lowest water. The bed is partly rock, with some sand. All the water passes beneath the bridge at all stages.

Gage heights are determined directly from the bench mark, which is the top of the downstream end of the first floor beam from the left end of the bridge; elevation, 16.00 feet above the datum of the assumed gage.

Discharge measurements of Green River near Flat Rock, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
November 13	W. E. Hall	45	87	0.84	1.65	73
November 13	do	45	88	.82	1.65	72

SALUDA RIVER NEAR WATERLOO, S. C.

This station was established August 30, 1896, by E. W. Myers. It is located at the Charleston and Western Carolina Railroad bridge between Coronaca and Waterloo, 3 miles from Waterloo and 9 miles from Greenwood. It is 1 mile below the mouth of Reedy River.

The channel is straight for about 600 feet above and below the station. Both banks are low and wooded and are subject to overflow, but all of the water passes beneath the bridge and its approaches. The channel is broken only by the piers of the bridge and trestle bents. The width of the stream at low water is about 200 feet, and the velocity is moderate.

Discharge measurements are made from the bridge, which is a steel structure of two spans of about 125 feet each, with wooden trestles 600 feet long on the left bank and 200 feet on the right bank. The initial point for soundings is the end of the guard rail of the trestle on the left bank.

A standard chain gage is located on the downstream side of the bridge, on the span next the left bank; length of chain, 45.85 feet. The gage is read once each day by R. N. Cunningham. Bench marks were established as follows: (1) A point on the top surface of the downstream end of the first floor beam to the left of the center pier; elevation, 44.64 feet. (2) A copper bolt set in a granite bowlder on the right bank of the stream 470 feet from the end of the trestle (measured along the railroad track) and 50 feet upstream from the center of the track; elevation, 61.44 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 68; WS 15, p 38; 27, p 28; 36, p 126; 48, p 147, 65, p 250; 83. p 84; 98, pp 51-52; 127, pp 32-33, 36.

Discharge: Ann 18, iv, p 68; 22, iv, p 159; WS 15, p 38; 36, p 126; 48, p 147; 65, p 250; 83, p 85; 98, p 52; 127, pp 33, 36.

Discharge, monthly: Ann 20, iv, p 153; 21, iv, p 129; WS 75, p 61; 83, p 86; 98, p 54; 127, p 35.

Discharge, yearly: Ann 20, iv, p 50.

Gage heights: WS 11, p 19; 15, p 38; 27, p 39; 36, p 127; 48, p 148; 65, p 251; 83, p 85; 98, pp 52-53; 127, p 34.

Hydrographs: Ann 20, iv, p 154; 21, iv, p 130; 22, iv, p 159; WS 75, p 61.

Rating tables: WS 27, p 46; 39, p 444; 52, p 513; 65, p 320; 83, p 86; 98, p 53; 127, p 34.

Discharge measurements of Saluda River near Waterloo, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 9	J. M. Giles	185	698	1.97	6.87	1,380
March 17	do	192	838	1.97	7.35	1,650
May 24	B. S. Drane	198	782	1.96	7.05	1,532
May 31	do	195	674	1.73	6.32	1,163
June 28	A. T. Mitchelson	195	595	1.8	6.29	1,071
October 16	F. A. Murray	185	447	1.88	5.78	839
October 16	do	185	434	1.89	5.66	821

Daily gage height, in feet, of Saluda River near Waterloo, S. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.6	.....	6.4	6.1	6.05	6.45	8.8	5.5	6.0	5.7	5.85	5.65
2	5.6	.....	6.6	5.6	5.7	6.25	14.6	5.35	7.4	4.75	5.55	5.65
3	5.85	.....	6.5	5.55	7.4	6.15	15.8	5.55	8.1	5.45	5.9	8.8
4	5.65	.....	6.4	6.2	9.1	6.15	11.2	5.45	6.7	5.65	5.7	12.8
5	5.55	.....	6.8	6.2	8.0	6.0	8.6	5.5	6.5	5.6	5.45	8.9
6	5.9	5.0	[illegible]	6.45	7.5	5.9	9.6	6.7	5.75	5.6	5.3	7.4
7	6.8	[illegible]	[illegible]	6.2	10.2	4.85	10.8	5.95	6.55	5.45	5.7	6.35
8	6.5	.....	6.1	6.75	9.2	6.5	9.0	6.9	5.5	5.65	5.65	6.25
9	5.45	7.4	6.3	6.25	9.8	5.1	7.6	8.5	6.1	4.85	5.75	8.6
10	5.85	8.7	6.8	5.5	7.4	5.6	7.2	8.3	6.45	5.55	5.8	10.6
11	5.8	8.5	6.4	6.35	6.6	5.25	7.2	9.4	5.45	5.85	5.8	8.8
12	5.7	9.6	7.2	6.45	6.5	4.7	10.8	12.8	5.45	8.1	5.2	7.9
13	11.0	12.6	6.3	6.1	7.1	5.45	15.6	12.4	5.6	6.65	5.35	6.7
14	10.6	12.6	7.0	6.2	6.8	5.6	14.2	8.8	5.95	5.85	5.7	6.4
15	8.0	9.2	6.8	6.3	6.25	5.5	12.6	7.4	5.75	5.85	5.75	7.0
16	7.2	7.7	6.2	5.7	6.65	5.55	9.3	10.2	5.65	5.8	5.45	6.7
17	6.25	7.0	6.6	5.8	6.55	5.6	8.2	7.4	6.15	5.5	5.75	6.95
18	6.0	6.9	6.2	5.85	6.5	9.4	7.8	7.0	5.2	5.6	5.75	6.8
19	6.05	6.8	6.2	5.55	6.45	7.2	7.6	7.0	5.85	5.9	5.2	6.5
20	6.1	8.6	5.55	5.8	6.35	6.6	7.2	7.0	5.6	5.55	5.5	12.0
21	6.45	14.8	6.4	5.65	6.3	6.35	7.0	6.65	5.5	5.7	6.1	15.0
22	6.3	13.8	6.35	6.75	6.1	6.05	7.0	6.2	5.45	5.95	7.1	14.7
23	5.85	10.4	6.45	5.45	7.9	5.9	6.95	6.15	5.95	5.35	5.95	9.0
24	6.1	8.6	6.2	5.2	7.0	6.45	6.7	6.25	5.7	5.55	5.9	8.4
25	5.8	8.0	6.05	5.7	6.85	5.85	6.2	11.1	4.6	5.7	5.0	7.9
26	5.7	7.6	6.3	5.7	6.65	5.25	6.85	9.5	5.4	5.65	4.65	7.5
27	5.7	7.4	5.7	5.8	6.55	6.85	5.9	6.0	5.55	5.65	4.65	6.9
28	5.85	6.75	6.2	5.75	6.45	5.25	5.75	6.25	5.45	5.95	5.2	7.7
29	.....	.....	6.3	5.95	6.35	5.6	6.7	6.3	5.4	6.5	5.7	8.0
30	.....	.....	5.95	5.9	6.45	5.6	6.4	5.3	5.5	5.4	5.75	7.6
31	.....	.....	6.0	.....	6.35	.....	5.4	5.45	.....	5.6	.....	7.6

NOTE.—The gage was read only once a day; and as there was a great daily fluctuation, caused by dams above, the one reading can not be relied on as giving the mean daily gage height.

Station rating table for Saluda River near Waterloo from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	200	5.10	550	6.30	1,150	8.00	2,250
4.00	219	5.20	592	6.40	1,205	8.20	2,400
4.10	240	5.30	636	6.50	1,260	8.40	2,560
4.20	262	5.40	682	6.60	1,320	8.60	2,725
4.30	286	5.50	730	6.70	1,380	8.80	2,900
4.40	312	5.60	780	6.80	1,440	9.00	3,085
4.50	340	5.70	830	6.90	1,500	9.20	3,280
4.60	370	5.80	880	7.00	1,560	9.40	3,485
4.70	402	5.90	930	7.20	1,690	9.60	3,700
4.80	436	6.00	985	7.40	1,820	9.80	3,920
4.90	472	6.10	1,040	7.60	1,960	10.00	4,150
5.00	510	6.20	1,095	7.80	2,100		

The above table is based on discharge measurements made during 1903–1905. It is well defined between gage heights 5 feet and 7 feet. Above 7 feet the curve is somewhat uncertain. Above gage height 10 feet the rating curve is a tangent, the difference being 120 per tenth.

Estimated monthly discharge of Saluda River near Waterloo, S. C., for 1905.

[Drainage area, 1,056 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 1-28	5,350	706	1,324	1.25	1.30
February 6-7, 9-28	9,910	[illegible]	3,319	3.14	2.57
March	1,690	[illegible]	1,191	1.13	1.30
April	1,410	5[illegible]2	[illegible]71	.920	1.03
May	4,390	830	1,688	1.60	1.84
June	3,485	402	1,008	.955	1.07
July	11,110	682	3,447	3.26	3.76
August	7,510	636	2,080	1.97	2.27
September	2,325	370	941	.891	.994
October	2,325	419	865	.819	.944
November	1,625	386	793	.751	.838
December	10,150	805	2,821	2.67	3.08

SALUDA RIVER NEAR NINETY SIX, S. C.

This is a temporary station, located at the highway bridge known as Watts Bridge, about 6 miles northeast of Ninety Six, S. C. It was established in 1905, in an endeavor to find a better measuring section than the one at the Waterloo station.

The channel is slightly curved both above and below the station. Both banks will overflow for 800 to 1,000 feet at highest water, but only an exceptional flood will go beyond the abutments of the bridge. The current is swift and somewhat irregular. The bed is partly rock.

A temporary gage was read twice each day during a part of November and December, 1905. The average of the two daily gage readings is published, but it is doubtful if these give the true mean daily gage heights, owing to the stored water above. The bench mark is the top of the downstream end of the second-floor beam from the right-bank pier; elevation, 29.00 feet above gage datum.

Discharge measurements of Saluda River near Ninety Six, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
September 8	W. E. Hall	156	609	2.09	4.81	1,273
October 17	F. A. Murray	156	524	2.03	3.47	1,062
October 21	do	156	496	2.13	3.34	1,057

Daily gage height, in feet, of Saluda River near Ninety Six, S. C., for 1905.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1		2.9	2.95	12			6.6	22		2.48	
2		2.75		13		2.2	5.1	23	2.3	2.75	[illegible]
3		2.2		14		2.3	4.7	24	2.9	2.65	
4		2.65		15		2.5	5.1	25	2.9	2.55	8.0
5			7.9	16		2.5	4.8	26	3.3		[illegible]
6		2.9	5.7	17		2.65		27	2.2	2.8	4.9
7		3.3	5.0	18		2.6	4.4	28	3.2	2.9	
8		2.25	4.4	19			4.6	29		2.7	6.4
9		2.8	6.7	20		2.2		30	2.3	2.7	
10		2.2		21		2.45		31	3.0		
11		2.7	7.2								

MISCELLANEOUS MEASUREMENTS IN SANTEE RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Santee River drainage basin during 1905:

Green River near Rutherfordton, N. C.—A measurement was made April 18, 1905, at Cox Bridge, 9 miles from Rutherfordton, N. C. The bench mark is the top of iron plate over eyebar over downstream end of first-floor beam from the left end of the bridge; elevation, 23.00 feet above the datum of the assumed gage.

Width, 86 feet; area, 137 square feet; mean velocity, 1.80 feet per second; gage height, 1.08 feet; discharge, 247 second-feet.

Muddy Creek near Bridgewater, N. C.—A measurement was made April 19, 1905, at a bridge near Bridgewater, N. C. The bench mark is a head of a copper nail driven into the top edge of the downstream edge of the floor beam toward the right bank; elevation, 7.00 feet above the datum of the assumed gage.

Width, 58 feet; area, 68 square feet; mean velocity, 1.41 feet per second; gage height, 1.24 feet; discharge, 96 second-feet.

Saluda River at Chappells, S. C.—A measurement was made June 27, 1905, from the upstream side of a wooden highway bridge, about 400 feet from the Southern Railway depot at Chappells, S. C. The bench mark is the top of the upstream stringer, 18 feet from the right end of the bridge; elevation, 31.56 feet above the datum of the assumed gage. The discharge of a small channel, which could not be measured, was estimated at 15 second-feet.

Width, 91 feet; area, 532 square feet; mean velocity, 2.04 feet per second; gage height, 2.26 feet; discharge, 1,083 second-feet.

Saluda River at Columbia, S. C.—Measurements were made by R. H. Anderson, in investigating power possibilities at Columbia. He assumed the zero of the gage to be the height of the water at the lowest measurement.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Second-feet.*		*Feet.*	*Second-feet.*
October 10	0.15	760	October 16	0.40	1,150
October 11	.00	600	Do	.35	1,050
October 14	1.05	2,400	October 17	.30	950

Saluda River near Newberry, S. C.—Measurements were made from Higgins Ferry Bridge, 8 miles southwest of Newberry, S. C. The initial point for soundings is the center of the downstream tubular pier at the left bank. The bench mark is the top of the downstream

end of the second iron crossbeam from the left-bank tubular pier; elevation, 29.00 feet above the datum of the assumed gage.

March 16: Width, 138 feet; area, 730 square feet; mean velocity, 2.43 feet per second; gage height, 4.05 feet; discharge, 1,778 second-feet.

October 20: Width, 133 feet; area, 465 square feet; mean velocity, 1.81 feet per second; gage height, 2.43 feet; discharge, 841 second-feet.

Saluda River near Prosperity, S. C.—Measurements were made from the upstream side of a new steel bridge 8 miles south of Prosperity and about 1½ miles downstream from Wise's ferry. The initial point for soundings is the right end of the bridge at the upstream side. The bench mark is the top of the upstream end of the first crossbeam from the right end of the bridge; elevation, 31.00 feet above the datum of the assumed gage.

March 15: Width, 182 feet; area, 1,163 square feet; mean velocity, 1.71 feet per second; gage height, 3.35 feet; discharge, 1,986 second-feet.

May 30: Width, 180 feet; area, 860 square feet; mean velocity, 1.70 feet per second; gage height, 2.74 feet; discharge, 1,463 second-feet.

SAVANNAH RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Savannah River is formed by the junction of Tugaloo and Seneca rivers, which unite about 100 miles above Augusta, Ga. It flows in a southeasterly direction, forming the boundary between Georgia and South Carolina, and empties into the Atlantic Ocean near Savannah, Ga. It is navigable to Augusta, which is at the fall line.

Seneca River is formed by the junction of Little and Keowee rivers, about 5 miles northeast of Seneca, S. C. Both of these tributaries rise in the Blue Ridge in North Carolina and the northwestern part of South Carolina.

Tugaloo River is formed by the junction of Chattooga and Tallulah rivers, which join at the west corner of Oconee County, S. C. It flows in a southeasterly direction, and is a part of the boundary between Georgia and South Carolina. Chattooga River rises in Jackson County, N. C., and flows in a southwesterly direction along the boundary between Georgia and South Carolina. Tallulah River rises in Macon County, N. C., and the northwestern part of Rabun County, Ga., and flows in a southeasterly direction. Parts of its course are cut through solid rock for hundreds of feet, forming canyons and steep bluffs. Throughout its entire length the fall is very great, and at Tallulah Falls the stream drops more than 500 feet in a short distance.

Broad River joins the Savannah at the southeast corner of Elbert County, Ga. It rises in Habersham and Bank counties and flows in a southeasterly direction to the southeast corner of Madison County, Ga., where South Fork joins it. Thence it flows east to Savannah River. Its drainage is from a rolling country, and there is a considerable amount of fall at various points. At Anthony Shoals the fall is more than 50 feet in a short distance. Above Augusta, Ga., there is much fall, which can be developed for water power. With exception of the large plant at Augusta, very little of this is being used.

The following pages give the results of the data collected in this drainage during 1905.

TALLULAH RIVER AT TALLULAH FALLS, GA.

This station was originally established August 29, 1900, by M. R. Hall, and records of gage heights were obtained until October 19, 1900. The record was resumed January 18, 1901, and maintained until December 31, 1901. The station was reestablished July 10, 1904, when bench marks were determined and regular gage readings begun. The station is located at the wagon bridge about one-fourth mile above the falls and about the same distance from the village of Tallulah Falls, Ga.

The channel is nearly straight for 300 feet above and 200 feet below the station. The current is swift. Both banks are high, wooded, rocky bluffs and are not subject to overflow. The bed of the stream is composed of rock and is rough and permanent. There is but one channel at all stages.

Discharge measurements are made from the iron wagon bridge, which has a single span of 100 feet and rests on timber piers. The initial point for soundings is the end of the bridge on the upstream side at the left bank.

The original gage is a vertical rod, spiked to a small maple tree on the left bank of the river about 50 feet above the bridge. June 21, 1905, a 5-foot rod gage was fastened vertically to the solid rock on the right bank 25 feet above the bridge. The datum is the same as that of the original gage. The gage is read once each day by J. T. McKay, who is paid by the Georgia Geological Survey. Bench marks were established as follows: (1) The top of a large rock on the right bank, about 30 feet above the bridge; elevation, 7.50 feet. (2) A copper plug set in the solid rock on the right bank, about 7 feet to the right of the new gage and 27 feet upstream from the upper edge of the bridge; elevation, 7.05 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 148; 65, p 251; 127, pp 37-38.
Discharge: 48, p 148; 65, p 251; 98, p 71; 127, p 38.
Discharge, monthly: 75, p 62; 127, p 39.
Gage heights: 48, p 148; 65, p 252; 127, p 38.
Rating tables: 52, p 513; 65, p 320; 127, p 39.

Discharge measurements of Tallulah River at Tallulah Falls, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 3	W. E. Hall	60	419	1.12	1.70	471
May 11	F. A. Murray	58	428	1.41	1.83	605
May 27	W. E. Hall	60	410	1.64	2.10	673
May 28	do	60	406	1.68	2.10	681
June 21	A. T. Mitchelson	60	388	.97	1.34	375
June 22	do	60	412	1.50	1.77	621
July 18	Hall and Hoyt	61	421	1.67	2.08	705
July 18	do	61	424	1.60	2.08	683
September 6	F. A. Murray	57	389	.81	1.15	317
October 24	do	56	340	.67	.89	228
November 15	do	56	339	.58	.82	196

Daily gage height, in feet, of Tallulah River at Tallulah Falls, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.2	1.8	1.6	1.7	1.2	3.5	1.4	1.1	0.8	0.9	0.9
2	1.0	1.1	1.7	1.6	1.6	1.2	1.9	1.4	1.1	.9	.9	1.0
3	1.0	1.1	1.7	1.5	1.8	1.1	1.4	1.3	1.0	.9	.9	4.5
4	.9	1.2	1.7	1.4	2.1	1.1	1.8	1.3	.9	1.1	.9	2.9
5	.9	1.2	1.6	1.8	2.0	1.1	2.0	1.4	.9	.9	1.0	2.5
6	1.0	1.5	1.7	1.6	2.9	1.2	4.2	1.4	1.1	.9	.9	1.3
7	1.8	1.8	1.7	1.7	2.9	1.2	1.3	1.3	1.0	.8	.9	1.2
8	1.3	1.8	1.8	1.7	2.2	1.4	1.7	2.3	1.1	.8	.9	1.4
9	1.1	2.7	3.5	1.5	2.1	1.3	1.6	2.1	1.1	1.1	.9	4.7
10	1.0	2.5	2.8	1.5	1.8	1.3	1.7	2.2	1.1	1.2	.8	2.8
11	1.1	2.3	2.3	1.5	1.7	1.4	3.5	2.5	1.0	3.1	.8	2.1
12	6.5	2.1	2.0	1.6	1.6	1.3	4.6	2.6	1.0	1.5	.8	1.8
13	3.2	3.2	1.8	1.6	1.6	1.2	3.4	2.5	1.0	1.3	.8	1.6
14	2.3	2.3	2.8	1.7	1.6	1.2	4.4	2.6	1.0	1.1	.8	1.6
15	1.9	2.1	1.7	1.7	1.7	1.3	3.0	2.0	.9	1.1	.8	1.7
16	1.6	1.8	1.7	1.8	3.1	1.4	2.4	1.8	1.0	1.1	.8	1.6
17	1.5	1.7	1.7	1.7	2.3	1.3	2.3	1.7	1.1	1.0	.9	1.7
18	1.4	1.5	1.6	1.7	2.0	1.4	2.1	1.7	1.0	1.0	.9	1.5
19	1.5	1.4	1.5	1.5	1.8	1.6	2.0	1.5	1.0	1.0	.9	1.5
20	1.4	2.5	1.7	1.5	1.6	1.7	2.1	1.6	.9	1.0	1.0	2.3
21	1.4	3.3	2.5	1.5	1.6	1.6	1.8	1.5	.9	1.0	1.0	2.1
22	1.4	3.0	2.0	1.5	1.8	1.8	1.7	1.4	1.0	1.0	.9	2.0
23	1.2	2.7	1.9	1.5	2.3	1.5	1.7	1.5	1.0	.9	.8	2.4
24	1.3	2.4	1.7	1.6	2.5	1.3	1.6	1.4	.9	.9	.9	2.4
25	1.3	2.2	1.7	1.6	1.8	1.3	1.6	1.5	.9	.9	1.0	2.5
26	1.1	2.0	1.8	1.7	1.9	1.2	1.7	1.5	.9	1.4	1.0	2.4
27	1.1	2.0	1.7	1.8	1.4	1.2	1.6	1.4	.8	1.3	.8	2.2
28	1.0	1.9	1.7	1.7	1.3	1.2	1.6	1.4	.8	1.2	.8	2.1
29	.9	.....	1.7	1.6	1.4	1.3	1.6	1.2	.8	1.0	.8	1.9
30	1.1	.....	1.6	1.9	1.2	1.4	1.4	1.2	.9	.9	.9	1.7
31	1.0	.....	1.6	.....	1.1	.....	1.4	1.1	.....	.9	.....	1.8

Station rating table for Tallulah River at Tallulah Falls, Ga., from July 15, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	125	1.10	290	1.80	575	2.50	1,000
.50	145	1.20	320	1.90	630	2.60	1,070
.60	165	1.30	355	2.00	685	2.70	1,145
.70	185	1.40	395	2.10	740	2.80	1,220
.80	210	1.50	435	2.20	800	2.90	1,300
.90	235	1.60	480	2.30	860	3.00	1,380
1.00	260	1.70	525	2.40	930		

The above table is based on 23 discharge measurements made during 1904-1905. It is well defined between gage heights 0.4 foot and 2 feet. The table has been extended beyond these limits. Above 3 feet gage height the discharge has been estimated.

Estimated monthly discharge of Tallulah River at Tallulah Falls, Ga., for 1905.

[Drainage area, 191 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,360	235	526	2.75	3.17
February	1,635	290	744	3.90	4.06
March	1,805	435	649	3.40	3.92
April	630	395	490	2.57	2.87
May	1,465	290	650	3.40	3.92
June	575	290	369	1.93	2.15
July	2,740	355	900	4.71	5.43
August	1,070	290	537	2.81	3.24
September	290	210	254	1.33	1.48
October	1,465	210	312	1.63	1.88
November	260	210	230	1.20	1.34
December	2,825	235	793	4.15	4.78
The year	4,360	210	538	2.82	38.24

TUGALOO RIVER NEAR MADISON, S. C.

This station was originally established July 19, 1898, at Cooks Ferry and was discontinued December 31, 1901, when the ferry was moved. It was reestablished July 7, 1903, by M. R. Hall, at Holcombs Ferry, 1 mile west of Madison, S. C., and 900 feet below the Southern Railway bridge. This station is about 1½ miles above the point where the old station was located.

The bed of the river is sandy and the current is moderately swift. The channel is about 160 feet wide and is fairly uniform in width and general appearance for some distance, being straight for 1,000 feet or more both above and below the station. The banks are both moderately high, but will overflow for about 200 feet on the right bank and 250 feet on the left. Both are open and cultivated except for a few trees along the edge of the river. These conditions make it possible to obtain fairly good float measurements at the time of floods.

Discharge measurements are made from the ferryboat, or a small boat which is held in place by a cable stretched across the river. The initial point for soundings is the land side of the windlass used for stretching the cable; it is located on the right bank. Distances are measured along the hand line which is used to pull the boat across the river.

The gage consists of a vertical timber in three sections. The first section reads from 1 to 16 feet and is attached to a sycamore tree on the left bank, about 30 feet above the ferry landing. The second section reads from 16 to 22 feet and is attached to a sycamore tree on the left bank, about 18 feet above the ferry landing. The third section reads from 21 to 31 feet and is fastened to a locust tree on the left bank at the forks of the road, about 175 feet from the ferry landing. The gage is read once each day by T. A. Spencer. Bench marks were established as follows: (1) A nail in a willow tree on the right bank, 20 feet below the ferry landing; elevation, 7 feet. (2) Two large nails in the locust tree to which the third section of the gage is fastened; elevation, 22 feet. (3) A copper plug set in solid rock on the north side of the railroad 10½ feet from the north rail and about 400 feet east of the east end of the Southern Railway bridge; elevation, 44.27 feet. (4) Geological Survey standard bronze tablet marked "666 Atlanta" on the right-bank pier of the Southern Railway bridge; elevation, 35.37 feet. Elevations refer to the datum of the gage. Bench mark No. 4 is 665.47 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper).

Description: WS 27, p 28; 36, pp 127-128; 48, p 149; 65, p 252; 98, pp 67-68; 127, pp 39-40.
Discharge: WS 36, p 128; 48, p 149; 65, p 252; 98, p 68; 127, p 40.
Discharge, monthly: Ann 20, iv, p 162; 21, iv, p 131; 22, iv, p 160; WS 75, p 63; 98, p 69; 127, pp 42.
Gage heights: WS 27, p 40; 36, p 128; 48, p 149; 65, p 253; 98, p 69; 127, p 41.
Hydrographs: Ann 20, iv, p 162; 21, iv, p 131; 22, iv, p 160.
Rating tables: WS 27, p 46; 39, p 444; 52, p 513; 65, p 320; 98, p 69; 127, p 41.

Discharge measurements of Tugaloo River near Madison, S. C., in 1905.

Date.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 7	J. M. Giles	165	584	2.26	3.38	1,317
March 20	do	163	585	2.13	3.25	1,243
March 21	do	163	691	2.25	3.75	1,552
March 21	do	163	731	2.46	4.00	1,795
May 1	B. S. Drane	164	596	2.12	3.31	1,264
June 29	A. T. Mitchelson	151	458	1.91	2.56	874
September 8	F. A. Murray	160	445	2.18	2.78	970
October 14	do	160	435	2.03	2.66	880
November 17	do	160	373	1.72	2.13	641

Daily gage height, in feet, of Tugaloo River near Madison, S. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.4	3.8	2.9	3.4	3.6	21.5	3.4	3.0	2.35	2.35	2.2
2	2.1	2.4	3.6	2.9	3.1	3.5	7.1	3.3	3.8	2.35	2.3	2.1
3	2.1	2.35	3.5	2.9	3.5	3.4	4.9	3.2	3.7	2.3	2.3	12.3
4	2.0	2.25	3.4	2.9	4.5	3.3	4.1	3.2	3.2	3.2	2.3	5.2
5	1.8	2.2	3.3	3.1	4.1	3.2	4.8	3.3	3.1	2.6	2.3	3.7
6	1.9	3.2	3.2	3.3	5.8	3.1	4.7	3.5	2.9	2.4	2.3	3.1
7	4.4	4.0	3.4	3.1	6.2	3.0	4.8	3.3	2.8	2.35	2.35	2.85
8	2.8	3.4	3.4	2.9	5.0	3.0	4.1	4.5	2.8	2.3	2.3	2.8
9	2.4	7.3	3.3	2.9	4.6	2.9	4.0	4.6	2.85	2.3	2.3	12.6
10	2.4	6.6	4.6	3.1	4.0	2.9	4.0	6.2	2.75	2.4	2.3	7.0
11	2.3	4.9	5.1	2.9	3.8	2.8	7.7	6.7	2.7	7.4	2.25	5.0
12	11.8	4.5	4.3	2.95	3.6	2.8	14.0	6.4	2.75	4.0	2.25	4.2
13	8.7	7.9	4.0	3.5	3.5	2.8	10.3	6.8	2.9	3.5	2.25	3.8
14	5.3	5.8	4.0	3.2	3.3	2.7	14.5	6.0	2.7	2.6	2.2	3.5
15	4.0	4.8	3.7	3.0	3.2	2.9	8.0	5.3	2.6	2.6	2.2	3.9
16	5.6	4.0	3.6	3.2	5.9	3.4	6.7	4.7	2.6	2.65	2.15	3.9
17	3.3	3.9	3.4	3.0	4.6	3.6	6.0	4.3	2.6	2.5	2.15	3.6
18	3.0	3.5	3.4	2.9	3.9	3.1	5.3	4.2	2.55	2.4	2.1	3.4
19	2.9	3.3	3.3	2.8	3.6	2.9	5.3	4.1	2.6	2.45	2.1	3.2
20	2.9	7.1	3.3	2.8	3.4	3.2	5.3	3.9	2.6	2.45	2.55	3.4
21	2.8	9.5	3.5	2.75	3.3	3.4	4.7	3.8	2.6	2.45	2.35	7.0
22	2.6	6.9	4.1	2.8	3.5	3.8	4.5	3.7	2.5	2.3	2.2	5.2
23	2.5	5.0	3.7	2.7	6.2	3.3	4.2	3.5	2.45	2.35	2.15	4.4
24	2.5	5.1	3.5	2.7	6.6	3.0	4.1	3.9	2.4	2.3	2.1	4.6
25	2.4	4.7	3.4	2.65	4.5	2.8	4.0	3.8	2.35	2.35	2.3	4.1
26	2.0	4.4	3.3	2.7	4.3	2.7	3.9	4.0	2.35	2.9	2.4	3.8
27	2.1	4.1	3.2	3.5	4.9	2.6	3.8	3.4	2.3	2.7	2.25	3.6
28	2.4	4.0	3.1	3.3	5.4	2.65	3.7	3.3	2.3	2.5	2.15	3.5
29	2.3	.....	3.1	3.0	4.6	2.6	3.8	3.2	2.3	2.45	2.15	4.5
30	2.4	.....	3.0	4.0	4.1	15.0	3.6	3.1	2.3	2.4	2.2	3.9
31	2.4	.....	3.0	.....	3.9	.....	3.5	3.0	.....	2.4	.....	3.6

Station rating table for Tugaloo River near Madison, S. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	600	3.30	1,275	4.60	2,240	5.90	3,460
2.10	640	3.40	1,340	4.70	2,325	6.00	3,560
2.20	680	3.50	1,405	4.80	2,410	6.20	3,760
2.30	725	3.60	1,470	4.90	2,500	6.40	3,960
2.40	770	3.70	1,540	5.00	2,590	6.60	4,160
2.50	820	3.80	1,610	5.10	2,680	6.80	4,360
2.60	870	3.90	1,680	5.20	2,770	7.00	4,560
2.70	925	4.00	1,755	5.30	2,860	7.20	4,780
2.80	980	4.10	1,830	5.40	2,960	7.40	5,000
2.90	1,035	4.20	1,910	5.50	3,060	7.60	5,220
3.00	1,095	4.30	1,990	5.60	3,160	7.80	5,440
3.10	1,155	4.40	2,070	5.70	3,260	8.00	5,660
3.20	1,215	4.50	2,155	5.80	3,360		

The above table is based on 10 discharge measurements made during 1905. It is well defined between gage heights 2 feet and 4 feet. Above 4 feet the table is uncertain, the high water estimates being rough approximations. Above gage height 8 feet the rating curve is a tangent, the difference being 120 per tenth.

Estimated monthly discharge of Tugaloo River near Madison, S. C., for 1905.

[Drainage area, 593 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	10,220	520	1,442	2.43	2.80
February	7,460	680	2,494	4.21	4.38
March	2,680	1,095	1,466	2.47	2.85
April	1,755	898	1,107	1.87	2.09
May	4,160	1,155	2,087	3.52	4.06
June	14,060	870	1,572	2.65	2.96
July	21,860	1,405	4,025	6.79	7.83
August	4,360	1,095	1,986	3.35	3.86
September	1,610	725	942	1.59	1.77
October	5,000	725	996	1.68	1.94
November	845	640	704	1.19	1.33
December	11,180	640	2,414	4.07	4.69
The year	21,860	520	1,770	2.98	40.56

SAVANNAH RIVER AT WOODLAWN, S. C.

This station was established November 9, 1905, by M. R. Hall. It is located at the Charleston and Western Carolina Railway bridge, 1,000 feet from the depot at Woodlawn, S. C., 17 miles above Augusta, Ga., and 10 miles above the Augusta water-power dam.

The flow of the river is almost natural at this point, being affected very slightly by stored water mostly from Seneca River. The river is divided by a low island into two channels. The east channel is the main part of the river, as there is very little water flowing in the west channel at ordinary stages and probably none at the lowest stage. The channel is practically straight at the station. The left bank is high and will not overflow except under the short trestle approach. The island and the bank for a short distance west of the

west channel will overflow. The current is swift, and is good in the greater part of the section at low water, but at places it is broken and irregular or is sloping with the direction of the section. The bed of the stream is mostly rock, the considerable roughness of which causes the irregularities in the current above mentioned. Careful measurements should give good results at this station.

Discharge measurements are made from the upstream side of the railroad bridge, which is in four spans over the east channel and a single span over the west channel. Across the island between the two channels there is about 900 feet of wooden trestle.

The present gage is a vertical rod attached to a timber which is driven into the bed of the river and spiked to a tree on the left bank about 40 feet upstream from the bridge. It is read twice each day by M. A. Palmore. The bench mark is the top of the upstream end of the second floor beam from the left end of the bridge; elevation, 37.00 feet above the datum of the gage.

Discharge measurements of Savannah River at Woodlawn, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
November 9	M. R. Hall	409	2,116	1.52	3.49	3,216
November 21	F. A. Murray	417	2,203	1.39	3.31	3,060

Daily gage height, in feet, of Savannah River at Woodlawn, S. C., for 1905.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		3.65	12	4.1	6.9	22	4.0	14.0
2		3.6	13	3.8	5.6	23	3.75	9.8
3		5.9	14	3.45	5.4	24	3.55	7.3
4		12.1	15	3.55	5.8	25	3.6	6.3
5		9.2	16	3.5	6.2	26	3.6	5.8
6		6.2	17	3.45	5.9	27	3.6	5.4
7		5.0	18	3.45	5.3	28	3.7	5.4
8		4.6	19	3.5	5.0	29	3.75	7.8
9	3.55	5.4	20	3.3	7.2	30	3.7	7.3
10	3.55	11.6	21	3.4	15.5	31		6.2
11	4.1	9.4						

SAVANNAH RIVER AT AUGUSTA, GA.

Observations of river heights have been maintained since 1875 by the city of Augusta, Ga., at the city highway bridge.

The channel is straight for a long distance above and below the bridge and is about 560 feet wide at low water. The banks are high, but will overflow at times under a part of the length of the approaches and, at very high stages, for a long distance on either side of the river beyond the ends of the bridge. The bed of the stream is sandy and undergoes considerable change. The current is swift.

Discharge measurements are made from the downstream side of the North Augusta bridge at Thirteenth street in the city of Augusta. This bridge consists of three spans, each 208 feet long, with 319 feet of wooden approach on the right bank and 259 feet on the left. The initial point for soundings is the end of the bridge at the right bank on the downstream side.

The gage, located at the Fifth Street Bridge, 1 mile below the measuring station, is a vertical timber fastened to the first bridge pier which is in the water, on the side of the pier

near the upstream corner, facing the right bank. Readings are made four times each day by J. M. Youngblood, keeper of the city bridge, usually at 6 a. m., 12 m., 6 p. m., and 9 p. m. The 6 a. m. readings are those used by the Weather Bureau, but in the publications of the United States Geological Survey since 1900 the average of all four of the daily readings is used and is reduced to feet and tenths of a foot. The zero of the gage is the datum of all the city levels, and any city bench mark can therefore be used. A point is established on the North Augusta bridge from which to measure down with a steel tape. This is the top of the plate through which the top pipe of the bridge fencing passes, which is riveted to the right side of the intermediate post at the downstream end of the third floor beam from the right-bank end of the bridge, and at ordinary stages it is 55.00 feet above water, less the reading of the gage.

The United States Weather Bureau has published the results of its observations in a volume entitled "Stages of Water at River Stations," as follows: Those for 1875 to 1889 are given in part 3, those for 1890 to 1892 in part 4, and those for 1893 to 1895 in part 5.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, p 147; 18, iv, p 75; Bull 140, pp 72-73; WS 27, pp 28-31; 33, p 130; 48, p 150; 65, p 254; 83, pp 87-88; 98, p 57; 127, pp 42-43.
Discharge: Ann 19, iv, p 227; WS 27, p 44; 36, p 131; 48, p 150; 65, p 254; 83, p 88; 98, p 58; 127, p 43.
Discharge, flood: Ann 14, ii, p 149.
Discharge, monthly: Ann 14, ii, pp 147-148; 18, iv, pp 76-77; 20, iv, pp 160, 165; 21, iv, 135; 22, iv, p 162; WS 27, p 30; 75, p 64; 83, p 89; 98, p 59; 127, p 45.
Discharge, yearly: Ann 20, iv, pp 50, 51.
Gage heights: Bull 140, p 73; WS 27, pp 41-42; 36, p 131; 48, p 151; 65, p 255; 83, p 88; 98, p 58; 127, p 44.
Hydrographs: Ann 20, iv, p 165; 21, iv, p 135; 22, iv, p 162; WS 75, p 64.
Rating tables: WS 27, p 29; 39, p 444; 52, p 513; 65, p 320, 83, p 89; 98, p 59; 127, p 45.

Discharge measurements of Savannah River at Augusta, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 29	M. R. Hall	528	3,306	1.61	7.72	5,233
April 12	Hall and Murphy	533	3,480	1.68	8.04	5,867
June 7	M. R. Hall	532	2,961	1.72	7.35	5,092
October 13	do	563	4,392	2.25	10.10	9,882
October 14	do	531	3,155	1.65	7.78	5,204
November 22	F. A. Murray	526	2,603	1.68	6.70	4,375

Daily gage height, in feet, of Savannah River at Augusta, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.5	7.2	9.6	7.6	6.6	8.1	11.3	6.8	7.1	5.0	6.2	6.3
2	7.6	7.1	9.4	7.6	8.6	7.9	22.6	6.9	7.0	5.8	6.1	6.1
3	7.5	7.2	9.1	7.5	8.3	7.7	20.2	7.0	9.2	5.3	6.1	8.1
4	7.3	7.0	8.8	7.5	10.9	7.1	12.3	6.9	9.5	5.6	5.9	20.6
5	7.2	7.2	8.6	7.5	12.3	7.2	9.6	6.7	8.2	6.4	6.0	20.3
6	7.2	7.1	9.0	7.8	11.0	7.2	9.5	6.4	7.6	7.5	6.3	12.6
7	7.5	7.3	8.1	8.1	11.5	7.0	13.1	6.7	7.1	6.6	6.1	9.3
8	8.6	9.0	8.2	8.2	18.1	7.1	12.1	7.3	6.9	5.4	5.6	8.4
9	8.8	13.4	8.5	7.4	15.0	6.8	10.4	9.1	6.8	6.0	6.2	9.4
10	8.0	16.9	8.5	7.7	12.1	6.6	9.3	11.1	6.5	5.8	6.1	19.0
11	7.7	17.2	8.7	8.3	10.0	6.2	8.1	9.3	6.8	6.3	6.4	18.2
12	7.7	16.4	10.6	7.9	9.0	6.7	11.5	12.6	6.6	6.6	7.6	14.0
13	12.0	23.5	12.3	8.5	8.3	6.4	18.4	13.8	6.3	9.8	7.2	10.6
14	17.9	25.3	9.8	8.8	7.9	6.6	20.7	13.3	6.6	7.9	6.5	9.4
15	14.2	20.9	9.9	8.4	7.9	7.4	16.5	10.6	7.0	6.7	6.3	9.9
16	10.8	16.3	9.3	8.2	7.8	7.6	13.1	9.5	6.7	6.8	6.4	11.2
17	9.2	12.5	8.9	8.2	7.9	7.4	11.1	9.6	5.9	6.5	6.3	10.4
18	8.7	10.8	8.6	7.3	9.4	7.7	9.3	9.4	6.5	6.5	6.2	9.6
19	8.4	10.2	8.5	7.4	8.2	7.8	9.5	8.8	6.3	6.4	5.6	9.1
20	8.2	10.1	8.4	7.4	7.6	7.5	9.3	8.5	5.6	6.5	6.2	10.2
21	8.3	18.0	8.4	7.4	7.4	7.1	9.1	8.5	6.2	6.0	6.1	27.6
22	8.2	23.5	8.7	7.1	7.8	7.1	8.4	7.8	6.1	5.8	6.5	27.5
23	8.2	20.2	9.0	6.9	8.4	7.8	7.6	7.9	6.1	6.5	7.0	21.5
24	8.0	15.6	8.6	6.9	14.6	7.8	7.9	8.7	5.4	5.8	6.4	16.2
25	7.7	12.4	8.2	6.9	14.2	6.9	7.6	9.2	5.8	6.1	6.4	12.4
26	7.5	11.4	8.4	7.0	11.4	6.9	7.6	10.9	5.7	5.9	5.4	10.8
27	7.2	10.7	8.4	7.0	9.7	6.8	7.5	10.5	5.9	5.9	6.5	9.8
28	7.0	9.7	7.6	7.3	9.5	6.6	7.3	9.0	5.7	6.1	6.3	9.7
29	6.8	.....	7.6	7.7	9.6	6.8	7.6	8.1	5.6	6.5	6.4	14.3
30	7.2	.....	7.8	9.2	9.4	6.5	7.7	7.7	5.2	6.4	6.3	14.0
31	7.2	.....	7.5	.....	8.7	.....	7.9	7.2	.....	6.1	.....	12.9

NOTE.—The gage-height records can be considered as only approximately representing the mean daily heights.

Station rating table for Savannah River at Augusta, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.00	2,650	6.70	4,190	8.80	7,200	13.50	16,850
5.10	2,725	6.80	4,300	9.00	7,600	14.00	17,900
5.20	2,800	6.90	4,410	9.20	8,000	15.00	20,100
5.30	2,880	7.00	4,520	9.40	8,400	16.00	22,400
5.40	2,960	7.10	4,630	9.60	8,800	17.00	24,800
5.50	3,045	7.20	4,740	9.80	9,200	18.00	27,300
5.60	3,130	7.30	4,860	10.00	9,600	19.00	30,100
5.70	3,220	7.40	4,980	10.20	10,000	20.00	33,300
5.80	3,310	7.50	5,100	10.40	10,400	21.00	36,900
5.90	3,400	7.60	5,220	10.60	10,800	22.00	41,000
6.00	3,495	7.70	5,340	10.80	11,200	23.00	45,800
6.10	3,590	7.80	5,470	11.00	11,600	24.00	52,000
6.20	3,690	7.90	5,600	11.50	12,650	25.00	60,000
6.30	3,790	8.00	5,740	12.00	13,700	26.00	68,800
6.40	3,890	8.20	6,050	12.50	14,750	27.00	77,600
6.50	3,990	8.40	6,400	13.00	15,800	28.00	86,400
6.60	4,090	8.60	6,800				

The above table is based on discharge measurements made during 1902–1905. It is fairly well defined between gage heights 6.6 feet and 13 feet. The table has been extended beyond these limits. Above gage height 8.3 feet the table is the same as that of 1903.

Estimated monthly discharge of Savannah River at Augusta, Ga., for 1905.

[Drainage area, 7,294 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	25,800	4,300	7,075	0.970	1.12
February	62,640	4,520	18,780	2.57	2.68
March	14,330	5,100	7,275	.997	1.15
April	8,000	4,410	5,416	.743	.829
May	27,580	4,090	9,764	1.34	1.54
June	5,890	3,690	4,704	.645	.720
July	43,880	4,860	12,620	1.73	1.99
August	17,480	3,890	7,745	1.06	1.22
September	8,600	2,800	4,218	.578	.645
October	9,200	2,650	3,916	.537	.619
November	5,220	2,960	3,789	.519	.579
December	82,880	3,590	19,270	2.64	3.04
The year	82,880	2,650	8,714	1.19	16.13

CHAUGA RIVER NEAR MADISON, S. C.

A station was established on Chauga River at Bryan wagon bridge, 2 miles east of Madison and 1 mile above the mouth of the river, by M. R. Hall, and measurements were made during 1900 and 1901, in connection with the old station on Tugaloo River at Cook's ferry, near Madison. When the Tugaloo River station was reestablished in 1903 the Chauga River station was also reestablished for the purpose of making a series of miscellaneous measurements.

The channel is straight for about 500 feet above the station; below it is curved for about 50 feet and then straight. The current is swift. The right bank is high, clean, and liable

to overflow during freshets. The left bank is high, rocky, wooded, and is not subject to overflow. Floods can not be measured, as high water goes over the bridge.

Discharge measurements are made from the upstream side of the single-span wooden bridge. The bridge is supported by log cribs which are filled with rock and anchored to bed rock. The initial point for soundings is the top of the anchor bolt in the upstream corner of the right-bank abutment.

Gage heights are determined directly from the bench marks. No. 1 is the top of the downstream guard rail 7 feet from the right bank; elevation, 10.00 feet. No. 2 is a large nail driven horizontally into the center of the downstream end of the lowest cross log of the right-bank crib abutment; elevation, 4.50 feet. Elevations refer to the datum of the assumed gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 127, p. 46.
Discharge: 98, p. 70; 127, p. 46.

Discharge measurements of Chauga River near Madison, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 1	B. S. Drane	41	78	1.74	1.23	136
June 29	A. T. Mitchelson	38	67	1.55	.97	104

SENECA RIVER NEAR CLEMSON COLLEGE, S. C.

This station was established as a regular station December 8, 1903, by M. R. Hall, at which time a standard chain gage and the bench marks were established. A vertical gage had been put in July 19, 1903, and records obtained from it for a portion of the time. Both gages are referred to the same datum. The station is located at the highway bridge about 3 miles south of Clemson College, S. C., and about 300 feet up the river from the crossing of the Blue Ridge Railroad.

At ordinary stages the channel is about 150 feet wide. The right bank is high and will not overflow, but the left bank will overflow for a considerable width at a gage height of about 23 feet. The bed of the river is sandy. The current is moderate. At low stages there is a daily fluctuation of about 1 foot in the gage heights, caused by the operations of water powers above.

The standard chain gage is located on the lower chord on the downstream side of the bridge; length of chain, 31.82 feet. The vertical gage is in 5-foot sections, fastened to the iron braces between the cylinders of the right-bank pier. Both gages are in good condition, except that mud accumulates at the lower end of the vertical gage. The gage is read twice each day by M. L. Sanders. Bench marks were established as follows: (1) The top of the upstream cylinder of the right-bank pier at a point marked "B. M." by chisel cuts; elevation, 28.95 feet. (2) A copper plug set in rock on the right bank under the railroad bridge, and about 20 feet to the right of the center pier; elevation, 10.27 feet. (3) A bench cut on the root of a hickory tree at the fork of the roads, about 100 feet from the right-bank end of the bridge; elevation, 30.52 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 65–66; 127, pp 46–47.
Discharge: 98, p 66; 127, pp 47–48.
Discharge, monthly: 98, p 67; 127, p 49.
Gage heights: 98, p 66; 127, p 48.
Rating table: 98, p 67; 127, p 49.

Discharge measurements of Seneca River near Clemson College, S. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 8	J. M. Giles	146	538	2.03	3.75	1,093
March 20	do	146	540	1.89	3.60	1,023
May 1	B. S. Drane	148	474	1.88	3.43	890
June 1	do	149	591	2.04	4.09	1,204
September 7	F. A. Murray	149	489	2.05	3.59	996
October 14	do	149	462	2.16	3.69	1,000

Daily gage height, in feet, of Seneca River near Clemson College, S. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.95	4.7	3.1	3.4	3.6	16.5	3.4	3.4	2.25	3.0	2.6
2	2.55	3.1	4.3	3.2	3.4	3.6	12.7	3.0	4.1	2.3	2.95	2.65
3	2.7	2.95	4.4	3.1	4.3	3.4	5.6	3.0	3.6	3.3	2.85	16.0
4	2.65	3.1	4.1	3.0	6.6	3.4	4.6	3.1	4.2	3.8	2.75	8.2
5	3.0	3.3	4.1	3.4	6.0	3.2	6.4	4.4	4.3	3.0	2.75	5.4
6	2.45	3.5	4.2	3.6	5.6	3.2	6.4	3.6	4.2	2.65	2.75	4.7
7	5.0	4.2	4.1	3.6	7.4	3.2	5.5	3.8	3.4	2.65	2.65	4.0
8	3.5	5.1	3.4	3.6	5.2	3.2	4.8	3.5	3.3	2.7	2.6	4.4
9	3.3	8.8	4.0	3.4	5.2	2.95	4.2	6.4	3.4	2.4	2.6	13.0
10	3.1	7.5	4.2	2.9	4.0	3.0	4.5	4.2	3.2	2.6	2.5	8.6
11	2.8	6.0	4.4	3.0	3.1	3.2	8.2	11.0	3.3	11.1	2.6	6.4
12	12.2	6.3	4.2	2.8	2.9	3.1	16.2	8.6	3.1	7.0	2.7	5.4
13	12.0	10.3	4.5	3.2	2.8	3.1	13.9	6.9	3.4	4.4	2.75	5.1
14	6.5	7.2	3.8	2.85	3.4	3.0	13.5	5.4	3.5	2.6	2.75	4.7
15	4.6	5.4	3.8	3.1	3.4	3.0	8.6	6.0	3.2	2.95	2.45	6.6
16	4.2	4.5	3.8	3.2	3.9	3.0	6.0	6.2	2.85	3.1	2.5	6.5
17	4.3	4.7	3.8	3.2	3.0	3.2	5.3	5.9	3.4	3.1	2.5	4.6
18	4.2	4.3	3.8	2.8	3.1	3.6	5.1	5.2	3.2	3.0	2.55	4.2
19	3.9	4.0	3.6	2.85	3.4	3.4	3.5	5.1	3.4	3.0	2.75	4.2
20	4.2	6.2	3.6	3.0	3.4	3.7	3.1	4.6	3.0	2.75	3.6	4.2
21	4.0	11.2	3.6	2.85	3.4	4.4	3.3	4.6	3.0	2.75	3.0	9.6
22	4.1	8.0	3.7	2.95	4.5	4.6	4.2	4.5	2.85	2.95	2.95	6.2
23	3.5	6.1	3.7	2.7	5.4	4.0	4.2	4.6	3.2	2.95	2.85	5.2
24	3.5	5.4	3.1	2.8	6.4	3.6	4.2	4.2	3.6	2.95	2.65	6.0
25	3.5	5.2	3.2	2.75	4.2	3.2	4.2	6.5	3.2	2.95	2.75	6.1
26	2.95	5.0	3.3	3.2	4.6	3.0	4.0	7.1	3.0	3.2	2.45	5.8
27	3.1	4.6	3.5	2.7	5.4	2.8	4.3	4.6	3.1	3.2	3.0	5.5
28	2.75	4.2	3.5	3.0	4.2	2.85	3.6	4.1	2.9	3.2	2.75	5.0
29	2.55	.....	3.2	2.95	4.6	2.9	4.2	3.8	2.4	2.9	2.35	5.0
30	3.1	.....	3.1	3.6	4.8	4.0	3.7	3.8	2.45	2.95	2.35	5.1
31	3.0	.....	3.0	.....	4.2	.....	4.0	3.4	.....	2.95	.....	5.8

Station rating table for Seneca River near Clemson College, S. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	285	2.60	644	3.80	1,096	5.00	1,620
1.50	310	2.70	678	3.90	1,138	5.20	1,720
1.60	336	2.80	713	4.00	1,180	5.40	1,820
1.70	363	2.90	749	4.10	1,222	5.60	1,920
1.80	391	3.00	785	4.20	1,265	5.80	2,020
1.90	420	3.10	822	4.30	1,308	6.00	2,120
2.00	450	3.20	859	4.40	1,351	6.20	2,230
2.10	481	3.30	897	4.50	1,395	6.40	2,340
2.20	512	3.40	936	4.60	1,440	6.60	2,450
2.30	544	3.50	975	4.70	1,485	6.80	2,560
2.40	577	3.60	1,015	4.80	1,530	7.00	2,670
2.50	610	3.70	1,055	4.90	1,575		

The above table is based on discharge measurements made during 1903–1905. It is fairly well defined between gage heights 1.4 feet and 6 feet. The table has been extended beyond these limits. Above 7 feet the discharge is estimated.

Estimated monthly discharge of Seneca River near Clemson College, S. C., for 1905.

[Drainage area, 646 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,530	594	1,287	1.99	2.29
February	4,980	767	1,926	2.98	3.10
March	1,485	785	1,100	1.70	1.96
April	1,015	678	817	1.26	1.41
May	2,890	713	1,370	2.12	2.44
June	1,440	713	921	1.43	1.60
July	7,895	822	2,433	3.77	4.35
August	4,870	785	1,675	2.59	2.99
September	1,308	577	905	1.40	1.56
October	4,925	528	967	1.50	1.73
November	1,015	561	688	1.07	1.19
December	7,620	644	2,199	3.40	3.92
The year	7,895	528	1,357	2.10	28.54

BROAD RIVER (OF GEORGIA) NEAR CARLTON, GA.

This station was established May 27, 1897, by M. R. Hall. The gage is now maintained and the observer paid by the United States Weather Bureau. The station is located at the Seaboard Air Line bridge 3 miles east of Carlton, Ga., and 2 miles above the mouth of the South Fork.

The channel above and below the station is straight for 500 feet. The right bank is high and is not liable to overflow. The left bank is low for about 400 feet, below which it is high and rocky. It overflows at a gage height of about 16 feet. The bed of the stream is sand and gravel and is somewhat changeable.

Discharge measurements are made from the upstream side of the bridge of two spans of 125 feet each, with trestle approaches 340 feet long on the left bank and 50 feet long on the right bank. The initial point for soundings is the end of the iron bridge on the right bank, upstream side.

A standard chain gage is fastened to the guard rail, with its bottom resting on the upstream end of the cross-ties. The center of the pulley is 39.5 feet from the initial point for soundings. The length of the chain is 54 feet. The gage is read once each day by S. P. Powers, jr. During the low water of October 1 to December 31, 1905, the gage was read twice each day. Bench marks were established as follows: (1) The top of the upstream iron girder under the cross-ties at a point about 40 feet from the initial point for soundings; elevation, 51 feet. (2) The top of the capstone of the right-bank pier at a point under the upstream side of the end of the bridge; elevation, 30.78 feet. (3) A copper plug set in solid rock in the railroad cut 1,135 feet from the west end of the iron bridge, 11 feet north of the center of the track, and at about the same elevation as the bottom of the cross-ties; elevation, 57.67 feet. Elevations refer to the datum of the gage, which is 384 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 15, p 40; 27, p 31; 36, pp 131-132; 48, p 151; 65, p 255; 83, p 92; 98, p 63; 127, p 50.
Discharge: WS 15, p 40; 27, p 44; 36, p 132; 48, p 151; 49, p 207; 65, p 255; 83, p 93; 98, p 63; 127, p 51.
Discharge, monthly: Ann 19, iv, p 227; 20, iv, p 163; 21, iv, p 132; 22, iv, p 163; WS 75, p 65; 83, p 94; 98, p 65; 127, p 52.
Discharge, yearly: Ann 20, iv, p 51.
Gage heights: WS 15, p 40; 27, p 42; 36, p 132; 48, p 152; 65, p 256; 83, p 93; 98, p 64; 127, p 51.
Hydrographs: Ann 19, iv, p 226; 20, iv, p 163; 21, iv, p 133; 22, iv, p 163.
Rating tables: Ann 19, iv, p 226; WS 27, p 46; 39, p 444; 52, p 513; 65, p 321; 83, p 94; 98, p 64; 127, p 52.

Discharge measurements of Broad River (of Georgia) near Carlton, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 18	J. M. Giles	172	413	1.80	2.50	745
January 18	do	172	409	1.86	2.50	762
March 18	do	164	442	1.45	2.25	642

Daily gage height, in feet, of Broad River (of Georgia) near Carlton, Ga., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.
1	2.2	2.0	2.5	2.1	2.2	2.3	6.3	1.7	1.6	1.4	1.65	1.7
2	2.2	2.0	2.5	2.1	2.1	2.1	4.3	1.6	3.0	1.5	1.65	1.7
3	2.2	2.0	2.5	2.1	2.2	2.1	3.0	1.6	2.4	1.6	1.65	9.4
4	2.1	2.0	2.4	2.1	5.3	2.0	2.2	1.6	2.0	2.0	1.6	8.4
5	2.0	2.0	2.4	2.2	3.4	2.0	2.4	1.6	1.7	2.2	1.6	4.2
6	2.0	2.2	2.4	2.3	4.9	1.9	8.2	1.6	1.7	1.7	1.6	3.5
7	2.6	2.6	2.3	2.2	6.8	1.9	3.6	1.6	1.7	1.6	1.7	3.0
8	2.7	3.0	2.3	2.1	6.9	1.9	2.8	1.6	1.6	1.5	1.65	2.5
9	2.4	4.0	2.3	2.2	4.4	1.8	2.0	3.1	1.6	1.5	1.65	7.0
10	2.2	5.7	2.5	2.2	3.4	1.8	2.0	2.2	1.6	1.6	1.8	7.9
11	2.2	5.4	2.4	2.1	2.8	1.8	3.9	2.7	1.6	2.0	2.0	5.4
12	2.8	4.4	2.5	2.1	2.5	1.7	3.6	3.2	1.6	2.6	1.8	4.3
13	6.1	6.6	2.6	2.2	2.4	2.1	5.0	4.0	2.3	2.2	1.7	3.3
14	6.0	6.4	2.5	2.2	2.3	1.9	4.4	2.6	1.9	1.8	1.7	2.9
15	3.5	4.7	2.4	2.1	2.2	3.0	3.8	2.6	1.7	1.7	1.7	3.0
16	3.0	3.3	2.4	2.1	2.3	2.0	3.0	2.4	1.6	1.7	1.6	3.0
17	2.7	3.0	2.3	2.1	2.7	2.0	2.5	2.0	1.6	1.7	1.6	2.7
18	2.6	2.9	2.2	2.1	2.5	2.0	2.3	2.0	1.5	1.65	1.6	2.6
19	2.4	2.8	2.2	2.0	2.4	2.0	2.1	2.2	1.5	1.7	1.6	2.6
20	2.6	3.0	2.2	2.0	2.2	2.7	2.6	2.0	1.5	1.7	1.65	4.3
21	2.5	7.8	2.3	2.0	2.2	1.9	2.0	1.9	1.5	1.7	1.95	7.8
22	2.4	8.5	2.3	2.0	2.2	2.2	2.5	1.9	1.5	1.6	1.9	5.7
23	2.2	5.0	2.3	2.0	2.4	2.0	2.3	1.8	1.5	1.6	1.7	3.0
24	2.2	3.7	2.3	2.0	4.5	2.0	2.0	2.2	1.4	1.6	1.7	2.5
25	2.1	3.3	2.3	2.0	4.4	1.9	1.8	2.2	1.4	1.6	1.7	2.4
26	2.1	3.0	2.2	2.0	2.9	1.9	1.8	2.8	1.4	1.8	2.1	2.3
27	2.1	2.8	2.2	2.0	2.8	1.7	1.8	2.6	1.4	2.0	2.1	2.2
28	2.1	2.7	2.1	2.0	2.7	1.7	1.7	2.2	1.4	1.8	1.95	2.2
29	2.0	.....	2.1	2.0	2.8	1.7	1.7	1.9	1.4	1.75	1.8	3.3
30	2.0	.....	2.1	2.1	2.6	1.6	1.7	1.7	1.4	1.7	1.75	2.9
31	2.0	.....	2.1	.....	2.3	.....	1.7	1.7	.....	1.7	.....	2.6

Station rating table for Broad River (of Georgia) near Carlton, Ga., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	270	2.90	1,060	4.40	2,320	6.60	4,880
1.50	305	3.00	1,130	4.50	2,420	6.80	5,140
1.60	340	3.10	1,200	4.60	2,520	7.00	5,400
1.70	380	3.20	1,280	4.70	2,620	7.20	5,680
1.80	420	3.30	1,360	4.80	2,720	7.40	5,960
1.90	460	3.40	1,440	4.90	2,820	7.60	6,240
2.00	510	3.50	1,520	5.00	2,920	7.80	6,520
2.10	560	3.60	1,600	5.20	3,140	8.00	6,800
2.20	610	3.70	1,680	5.40	3,360	8.20	7,080
2.30	670	3.80	1,770	5.60	3,600	8.40	7,360
2.40	730	3.90	1,860	5.80	3,840	8.60	7,640
2.50	790	4.00	1,950	6.00	4,100	8.80	7,920
2.60	850	4.10	2,040	6.20	4,360	9.00	8,200
2.70	920	4.20	2,130	6.40	4,620	9.50	8,950
2.80	990	4.30	2,220				

The above table is based on discharge measurements made during 1900-1905. It is well defined between gage heights 1.5 feet and 5.3 feet. The extension of the curve above 5.3 feet is based on one measurement at 9.1 feet.

Estimated monthly discharge of Broad River (of Georgia) near Carlton, Ga., for 1905.

[Drainage area, 762 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,230	510	934	1.23	1.42
February	7,500	510	2,046	2.69	2.80
March	850	560	687	.902	1.04
April	670	510	555	.728	.812
May	5,270	560	1,392	1.83	2.11
June	1,130	340	514	.675	.753
July	7,080	380	1,277	1.68	1.94
August	1,950	340	630	.827	.953
September	1,130	270	382	.501	.559
October	850	270	407	.534	.616
November	560	340	397	.521	.581
December	8,800	380	2,184	2.87	3.31
The year	8,800	270	950	1.25	16.89

MISCELLANEOUS MEASUREMENTS IN SAVANNAH RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Savannah River drainage basin during 1905:

Chattooga River near Tallulah Falls, Ga.—This river joins the Tallulah River and forms Tugaloo River. A measurement was made November 16, 1905, from a small boat at a point about 5 miles northeast of Tallulah Falls, Ga., at a narrow channel about 1,000 feet below Atkins Ferry and opposite B. H. Atkins's residence. There is a small shoal about 150 feet below and one 300 feet above the point of measurement. At the time of flood in

1876 the water is said to have been 36 to 40 feet higher than the present stage and did much damage to property. The bench mark is the center of the head of a wire nail driven horizontally into a sycamore stump which stands on the right bank about 200 feet above the point of measurement; elevation, 6.13 feet above the datum of the assumed gage. The gage height at the same time at the regular station on Tallulah River at Tallulah Falls was 0.82 foot.

Width, 107 feet; area, 442 square feet; mean velocity, 0.77 foot per second; gage height, 2.00 feet; discharge, 339 second-feet.

Little River near Washington, Ga.—Two measurements were made June 6, 1905, near Washington, Ga. The bench mark is the top of the downstream wooden stringer under the cross ties at the center of the first span of the railroad bridge at the right bank; elevation, 29.00 feet above the datum of the assumed gage.

Measurement at bridge of Washington Branch of Georgia Railroad: Width, 37 feet; area, 59 square feet; mean velocity, 0.58 foot per second; gage height, 1.40 feet; discharge, 34 second-feet.

Measurement at wagon bridge, 400 feet above railroad bridge: Width, 47 feet; area, 185 square feet; mean velocity, 0.19 foot per second; gage height, 1.40 feet; discharge, 35 second-feet.

Panther Creek near Tallulah Falls, Ga.—A measurement was made June 22, 1905, a short distance below where the Tallulah Falls Railroad crosses Panther Creek, near Tallulah Falls, Ga. The stage of the creek was probably somewhat high at the time of gaging, owing to showers the day before.

Width, 9 feet; area, 5.85 square feet; mean velocity, 1.17 feet per second; discharge, 6.82 second-feet.

Tugaloo River near Madison, S. C.—A measurement was made November 18, 1905, at Prathers Bridge, about 8 miles above the Southern Railway bridge near Madison, S. C. The initial point for soundings is the left end of the upstream guard rail at the end of the approach. The bench mark is the top of the upstream end of the second wooden cross beam from the left end of the bridge; elevation, 28.38 feet above the datum of the assumed gage. The gage height at the time by the gage at the regular station near Madison was 2.14 feet.

Width, 137 feet; area, 276 square feet; mean velocity, 2.22 feet per second; gage height, 2.15 feet; discharge, 614 second-feet.

OGEECHEE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Ogeechee River is formed by the junction of Williamsons Swamp Creek and Rocky Comfort Creek in Jefferson County, Ga., and drains a small basin in southeastern Georgia lying between the Savannah and Altamaha basins. Ogeechee River flows in a southeasterly direction and empties into the Atlantic Ocean. Its main tributary is Cannoochee River, which rises in Emanuel County, Ga., flows southeastward, and joins the Ogeechee about 20 miles from the Atlantic Ocean. The streams in this basin flow through a country that is mostly low. The current is generally good, but the fall available for power is probably small. The bank on one side or the other of the stream is generally low and swampy.

The following pages give the results of the data collected in this drainage during 1905.

CANNOOCHEE RIVER NEAR GROVELAND, GA.

This station was established June 12, 1903, by F. A. Murray. It is located at Moody's bridge, 3 miles south of Groveland, Bryan County, Ga.

The channel is straight for about 300 feet above and 400 feet below the station. The current is swift in the main channel, but sluggish near the banks. Both banks are of clay and sand and overflow at from 15 to 16 feet gage height. The bed of the stream is of silt and is shifting. There is but one channel at all stages, broken by the piers of the bridge, up to the height at which the river overflows its banks.

Discharge measurements are made from the downstream side of the nine-span wooden highway bridge. The initial point for soundings is the outer edge of the post which supports the end of the hand rail on the downstream side of the bridge on the left bank.

The original gage, reading from 0 to 17 feet, is nailed to the right side of the upstream post of the fourth bent from the left bank. From 17 to 20 feet the post is graduated to feet and half feet. A new gage, reading from 0 to 10 feet, is fastened to the left-bank side of the upstream post of the third bent from the left bank, this being the first bent in the water at ordinary stages. Another section of the gage, reading from 5 to 10 feet, is fastened to a gum tree on the left bank 25 feet above the bridge. This gage faces the bridge and is used for the stages which it covers. The gage is read once each day by J. M. Edwards. Bench marks were established as follows: (1) The top of the bridge floor at the fourth bent from the left end of the bridge on the upstream side opposite a point 61 feet from the initial point for soundings, marked by a cross and the letters "B. M." cut in the floor: elevation, 20 feet. (2) A spike in a pine tree which stands near the upstream side of the road 15 feet from the left end of the bridge and 9 feet upstream from the line of the edge of the bridge; elevation, 20.12 feet. (3) Two large wire nails driven into the tree to which the third section of the gage is fastened; elevation, 5.30 feet. Two more nails are also driven at the 8-foot mark.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp. 71-72; 127, pp. 56-57.
Discharge: 98, pp. 72, 79; 127, p. 57.
Discharge, monthly: 98, p. 74; 127, p. 59.
Gage heights: 98, pp. 72-73; 127, p. 58.
Rating table: 98, p. 73; 127, p. 58.

Discharge measurements of Cannoochee River near Groveland, Ga., in 1905.

Date.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	F. A. Murray	104	694	1.51	6.17	1,051
April 26	do	104	694	1.51	6.14	1,050
June 12	A. T. Mitchelson	87	209	.14	1.60	30
July 27	F. A. Murray	88	280	.50	2.51	140
July 27 [a]	do	78	103	1.29	2.50	13[illegible]
November 7 [a]	do	55	45	.51	1.25	23
November 7 [a]	do	55	44	.61	1.26	27

[a] Made at different section.

Daily gage height, in feet, of Cannoochee River near Graveland, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	3.3	9.8	6.2	4.9	2.5	2.0	3.0	3.2	1.5	1.4	1.3
2	2.6	3.3	8.7	6.2	4.9	2.6	2.2	3.9	3.0	1.5	1.3	1.3
3	2.6	3.3	7.7	5.5	4.9	2.4	2.5	3.6	2.8	1.5	1.3	1.8
4	2.6	3.3	7.5	5.3	4.7	2.3	2.4	3.5	2.4	1.4	1.3	2.2
5	2.6	3.2	7.0	5.1	4.5	2.1	2.3	3.5	2.0	1.4	1.3	2.5
6	2.6	3.4	6.3	5.4	4.5	1.9	3.7	3.4	2.4	1.4	1.3	2.4
7	2.7	3.6	6.4	5.7	4.5	1.8	4.5	3.0	2.6	1.4	1.3	2.2
8	2.9	4.0	6.2	5.7	4.5	1.8	7.4	2.8	2.4	1.5	1.3	2.3
9	2.9	4.7	6.2	5.6	4.4	1.7	7.5	2.6	2.2	1.6	1.3	2.5
10	2.8	5.3	6.2	5.6	4.3	1.7	7.7	2.5	2.2	1.5	1.3	2.8
11	2.8	5.6	6.7	6.0	4.0	1.6	7.7	2.2	2.0	1.4	1.5	2.8
12	2.8	6.6	8.0	6.0	3.4	1.6	7.9	2.0	2.0	1.4	1.5	2.7
13	3.0	8.1	10.4	6.4	3.0	1.6	8.0	2.3	1.9	1.4	1.5	2.5
14	3.5	10.1	13.4	7.2	3.0	1.6	7.2	2.6	1.8	1.4	1.5	2.8
15	4.0	11.2	14.2	7.4	3.0	1.6	6.5	3.1	1.8	1.4	1.4	3.0
16	4.5	11.9	14.1	9.2	2.9	1.8	6.5	3.1	1.9	1.4	1.3	3.4
17	4.4	13.1	13.9	6.8	2.5	2.0	6.5	3.1	1.8	1.4	1.3	3.3
18	4.3	14.8	13.8	6.5	2.4	2.6	6.0	3.2	1.7	1.4	1.3	3.2
19	4.2	14.5	13.7	6.5	2.4	2.8	6.2	3.3	1.9	1.3	1.3	3.0
20	4.1	13.1	13.0	6.4	2.4	3.1	6.3	4.0	1.9	1.3	1.3	3.1
21	4.1	11.0	12.1	6.2	2.4	3.3	5.3	5.0	2.0	1.3	1.3	3.6
22	4.0	10.5	11.2	6.0	2.6	3.0	3.8	5.6	2.0	1.3	1.3	4.3
23	3.9	11.6	10.2	5.9	2.7	2.5	3.2	6.0	1.8	1.3	1.3	4.2
24	3.6	11.7	9.2	5.8	2.8	2.6	3.1	4.2	1.7	1.3	1.4	4.8
25	3.6	11.5	8.0	5.9	2.9	2.6	2.6	3.3	1.7	1.3	1.4	5.1
26	3.5	13.0	8.9	6.1	2.8	2.5	2.1	3.0	1.6	1.4	1.4	5.0
27	3.5	12.0	7.6	6.1	2.8	2.3	2.0	3.2	1.6	1.4	1.4	4.8
28	3.4	10.7	6.9	5.8	2.8	2.0	2.2	3.5	1.6	1.4	1.3	4.7
29	3.2	.....	6.7	5.4	2.7	1.9	2.3	3.6	1.5	1.4	1.3	4.7
30	3.1	.....	6.5	5.0	2.6	1.8	2.3	3.7	1.5	1.4	1.3	4.8
31	3.3	.....	6.2	.....	2.5	.....	2.9	3.4	.....	1.4	.....	4.7

Station rating table for Cannoochee River near Groveland, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	23	2.60	144	4.00	405	6.80	1,183
1.30	27	2.70	158	4.20	453	7.00	1,245
1.40	32	2.80	172	4.40	503	7.20	1,309
1.50	38	2.90	187	4.60	554	7.40	1,373
1.60	44	3.00	203	4.80	606	7.60	1,438
1.70	51	3.10	220	5.00	660	7.80	1,504
1.80	58	3.20	238	5.20	714	8.00	1,570
1.90	66	3.30	257	5.40	769	8.20	1,638
2.00	75	3.40	276	5.60	825	8.40	1,706
2.10	85	3.50	296	5.80	882	8.60	1,775
2.20	96	3.60	317	6.00	940	8.80	1,845
2.30	107	3.70	338	6.20	1,000	9.00	1,915
2.40	119	3.80	360	6.40	1,060	9.50	2,095
2.50	131	3.90	382	6.60	1,121	10.00	2,275

The above table is based on discharge measurements made during 1903-1905. It is fairly well defined between gage heights 1.2 feet and 6.2 feet. The table has been extended beyond these limits. Above gage height 10 feet the rating curve is a tangent, the difference being 37.5 per tenth. Above 3.4 feet the table is the same as for 1904.

Estimated monthly discharge of Cannoochee River near Groveland, Ga., for 1905.

[Drainage area, 960 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	528	144	279	.291	.336
February	4,075	238	1,885	1.96	2.04
March	3,850	1,000	2,050	2.14	2.47
April	1,987	660	976	1.02	1.14
May	633	119	299	.311	.358
June	257	44	102	.106	.118
July	1,570	75	649	.676	.779
August	940	75	297	.309	.356
September	238	38	84.6	.088	.098
October	44	27	32.2	.034	.039
November	38	27	29.5	.031	.035
December	687	27	295	.307	.354
The year	4,075	27	582	.606	8.12

MISCELLANEOUS MEASUREMENT IN OGEECHEE RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurement was made in Ogeechee River drainage basin during 1905:

Lotts Creek near Groveland, Ga.—A measurement was made June 12, 1905, at a point 2 miles from Groveland, one-half mile above the mouth of the creek.

Width, 16 feet; area, 11.4 square feet; mean velocity, 1.18 feet per second; discharge, 13 second-feet.

ALTAMAHA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Altamaha River is formed by the junction of Oconee and Ocmulgee rivers, which unite at the southern boundary of Montgomery County, Ga. Ohoopee River is also a tributary and enters it from the north side, about 50 miles below the junction of the Oconee and Ocmulgee. The Altamaha River drainage basin is entirely within the State of Georgia. The river rises in the north-central part and flows in a southeasterly direction, emptying into the Atlantic Ocean near Darien. Below the junction of the Oconee and Ocmulgee and for a long distance above on both rivers there is no great amount of fall. Steamboat navigation is carried on from Darien to Macon on the Ocmulgee, and to Dublin, and at times to Milledgeville, on the Oconee.

Ohoopee River rises in Washington County and flows in a southeasterly direction to the Altamaha. It flows from low hills of southeastern Georgia into the flat pine lands. Though it has not so much fall as the more northern streams, it has considerable fall that can be developed into power.

Oconee River rises on the southern slope of the Chattahoochee Ridge, in Hall County, and joins the Middle Oconee on the southwest boundary of Clarke County. Thence it flows in a southeasterly direction to the Altamaha. Apalachee River is a large tributary which rises in Gwinnett and Walton counties and enters the Oconee near the southeast corner of Morgan County. Little River enters the main stream at the corner of Putnam, Hancock, and Baldwin counties, about 15 miles above Milledgeville, Ga. These tributaries have much fall, and a small part of it is developed. The Oconee has a fall of 250 feet in 45 miles. It has some very large waterpowers available from its source down to Milledgeville, where it crosses the fall line.

Ocmulgee River, the westernmost of the main tributaries, rises in the north-central part of Georgia on the southern slope of the Chattahoochee Ridge, in Fulton, Dekalb, and Gwinnett counties. It is formed by the junction of Yellow and South rivers just south of the south corner of Newton County. Yellow River rises in Gwinnett County and flows in a southerly direction into the Ocmulgee. South River rises in Fulton and Dekalb counties and flows in a southeasterly direction. Alcovy River joins the Ocmulgee about 5 miles below the junction of South and Yellow rivers. Towaliga River enters the Ocmulgee at about the southwest corner of Jasper County.

All these tributaries rise in and flow through a very hilly country and have a great deal of fall. Ocmulgee River has a fall of over 210 feet in 35 miles. The last fall of much size is only a few miles above Macon, Ga.

The following pages give the results of data collected in this drainage during 1905.

SOUTH RIVER NEAR SNAPPING SHOALS, GEORGIA.

This station was established in 1905 for the purpose of making a series of miscellaneous discharge measurements. It is located at a four-span wooden bridge, known as Butlers Bridge, about 15 miles south from Conyers, Ga., and 4 miles above Snapping Shoals, where there is a large amount of fall.

The current is smooth and is fairly swift at lowest water. It is broken by one pier at low water. The right bank may overflow beyond the bridge approach at high floods. The left bank will not overflow. The bed is sandy and will probably change.

Gage heights are determined directly from the bench mark, which is the top of the downstream end, at the edge of the floor, of the first wooden floor beam from the left end of the third span from the left bank; elevation, 25.00 feet above the datum of the assumed gage.

Discharge measurements of South River near Snapping Shoals, Georgia, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
October 23	M. R. Hall	83	87	1.38	3.46	120
October 24	do	83	98	1.38	3.56	135

OCMULGEE RIVER NEAR FLOVILLA, GA.

A station was established July 26, 1901, on Ocmulgee River at Lamars Ferry, one-half mile below Lamar's mill and 5 miles east of Flovilla, Ga. The object of this station was to compare the discharge of the river at this point with its discharge below, at Macon, through the low-water season. The gage and bench marks were washed away by a flood February 27, 1902. The station was reestablished June 18, 1903, at Lamars Ferry, by M. R. Hall.

The channel is straight for 1,000 feet above and 5,000 feet below the station. The current is swift and regular. The right bank is high, but overflows at extreme high water. The left bank is somewhat lower. The bed of the stream is sandy and shifting, and there is but one channel.

Discharge measurements are made from the ferryboat. The initial point for soundings is the windlass on the right bank.

The vertical gage is in three sections. The first section, reading from 0 to 5 feet, is fastened to a willow tree at the mouth of a small branch about 20 feet above the ferry landing on the right bank. The second section, reading from 5 to 15 feet, is nailed to an ash tree about 60 feet from the river up the same branch. The third section, reading from 15 to 25 feet, is attached to a cottonwood tree on the bank of the same branch, about 200 feet from the river. No attempt was made to place this gage on the same datum as the old one. The gage is read once each day by B. S. White, who is paid by the Georgia Geological Survey. During the low-water period from October 1 to December 31, 1905, the gage was read twice each day. Bench marks were established as follows: (1) A nail driven into a large cottonwood tree about 200 feet from the river, on the branch on which the gage is located; elevation, 14.00 feet. (2) A cross in the solid rock, 100 feet uphill from the first bench mark and 140 feet north from the wagon road, at a point 250 feet west of the ferry; elevation, 34.24 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 262; 83, p 110; 98, pp 97-98; 127, pp 63-64.
Discharge: 65, p 262; 83, pp 110, 113; 98, p 98; 127, p 64.
Discharge, monthly: 75, p 75; 83, p 111; 98, p 99; 127, p 66.
Gage heights: 65, p 263; 83, p 110; 98, p 98; 127, p 65.
Rating tables: 65, p 321; 83, p 110; 98, p 99; 127, p 65.

Discharge measurements of Ocmulgee River near Flovilla, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 25	W. E. Hall	210	685	1.69	1.88	1,155
June 15	A. T. Mitchelson	216	657	1.63	1.16	1,074
July 24	F. A. Murray	200	324	1.53	.34	496
September 29	M. R. Hall	185	201	1.46	− .32	293
November 3	F. A. Murray	195	300	1.58	.27	474

Daily gage height, in feet, of Ocmulgee River near Flovilla, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.4	2.6	1.5	1.4	1.0	6.0	0.5	0.3	−0.2	0.35	0.65
2	1.5	1.5	2.5	1.5	1.3	.8	6.0	.4	.7	.4	.25	.65
3	1.4	1.4	2.4	1.4	2.1	.7	4.2	.3	1.6	1.15	.20	11.2
4	1.2	1.5	2.3	1.6	3.0	.8	2.4	.0	.5	.65	.15	14.4
5	1.1	1.4	2.1	1.7	3.2	.7	2.5	.1	.6	.60	.1	10.4
6	1.3	1.5	2.0	2.2	2.5	.7	2.1	.2	.5	.45	.1	4.8
7	1.7	1.4	2.0	2.0	2.0	.6	3.7	.3	.3	.25	.5	4.0
8	1.8	5.0	2.0	1.8	1.8	.5	2.6	.5	.1	−.1	.4	3.4
9	1.8	6.9	2.0	2.2	1.9	.4	2.4	2.1	.2	−.15	.3	6.6
10	1.4	7.1	2.4	4.3	1.5	.2	1.7	2.5	.0	.05	.9	8.6
11	1.5	6.2	2.1	3.0	1.3	.0	4.3	2.9	−.1	.8	3.5	6.1
12	2.0	5.5	2.4	2.4	1.2	.0	3.4	9.2	−.1	1.05	2.55	4.2
13	6.2	12.6	3.0	2.1	1.0	1.7	7.0	6.3	.1	.75	1.75	4.0
14	6.9	10.5	2.7	1.9	.9	1.0	4.0	4.3	.1	.5	1.25	3.6
15	6.0	7.2	2.5	1.5	.8	.7	2.9	5.8	.2	.35	1.0	4.0
16	2.1	5.0	2.2	2.0	1.5	1.2	2.1	3.7	.0	.3	.65	3.8
17	2.8	4.2	1.9	1.8	1.4	1.1	1.7	2.2	.1	.4	.25	3.4
18	2.6	4.0	1.9	1.6	1.3	.9	1.5	2.0	.0	.3	.4	3.0
19	2.1	3.5	1.8	1.4	1.0	.7	1.2	1.4	−.2	.42	.5	1.9
20	2.1	3.3	1.7	1.5	.8	.4	1.0	1.1	−.2	.72	.45	7.2
21	2.0	5.5	2.1	1.4	.6	.3	.9	.9	−.2	.0	.55	14.6
22	1.8	6.6	2.5	1.3	.8	.2	.6	.8	−.3	.0	.6	9.3
23	1.7	5.3	2.2	1.3	1.3	1.8	.4	.7	−.3	.0	.58	5.0
24	1.6	4.3	2.0	1.3	3.9	2.3	.3	2.5	−.4	.2	.5	6.0
25	1.4	3.9	1.9	1.3	4.0	1.3	.6	2.4	−.5	.2	.5	5.2
26	1.3	3.6	1.7	1.2	3.6	1.1	1.9	1.2	−.6	.7	.5	3.6
27	1.4	3.2	1.6	1.2	2.2	1.5	1.5	.7	−.4	.7	.75	3.5
28	1.3	2.8	1.5	1.1	2.0	1.9	.8	.5	−.5	.6	.85	3.4
29	1.5	.....	1.4	1.0	1.9	2.2	.5	.4	−.4	.4	.80	3.8
30	1.4	.....	1.5	2.0	1.7	1.4	.3	.4	−.2	.35	.75	3.6
31	1.5	.....	1.4	.....	1.5	.....	.2	.3	.....	.3	.....	3.5

Station rating table for Ocmulgee River near Flovilla, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
− .6	220	0.90	690	2.40	1,370	4.80	2,940
− .5	245	1.00	730	2.50	1,420	5.00	3,090
− .4	270	1.10	770	2.60	1,470	5.20	3,240
− .3	295	1.20	810	2.70	1,525	5.40	3,395
− .2	325	1.30	850	2.80	1,580	5.60	3,555
− .1	355	1.40	895	2.90	1,635	5.80	3,715
.0	385	1.50	940	3.00	1,690	6.00	3,875
.10	415	1.60	985	3.20	1,820	6.20	4,035
.20	445	1.70	1,030	3.40	1,950	6.40	4,195
.30	475	1.80	1,075	3.60	2,080	6.60	4,355
.40	510	1.90	1,120	3.80	2,210	6.80	4,515
.50	545	2.00	1,170	4.00	2,350	7.00	4,675
.60	580	2.10	1,220	4.20	2,490	7.50	5,085
.70	615	2.20	1,270	4.40	2,640	10.50	7,650
.80	650	2.30	1,320	4.60	2,790	11.00	8,100

The above table is based on discharge measurements made during 1904-05. It is fairly well defined between gage heights −0.5 foot and 5.5 feet. The table has been extended beyond these limits, being based on logarithmic extension above 7 feet. Above gage height 3 feet the table is the same as that for 1904.

Estimated monthly discharge of Ocmulgee River near Flovilla, Ga., for 1905.

[Drainage area, 1,500 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,595	770	1,328	0.885	1.02
February	9,540	895	2,917	1.94	2.02
March	1,690	895	1,212	.808	.932
April	2,565	730	1,071	.714	.797
May	2,350	580	1,107	.738	.851
June	1,320	385	722	.481	.537
July	4,675	445	1,457	.971	1.12
August	6,530	385	1,273	.849	.979
September	985	220	402	.268	.299
October	790	325	512	.341	.393
November	2,015	415	651	.434	.484
December	11,340	598	3,592	2.39	2.76
The year	11,340	220	1,354	.902	12.19

OCMULGEE RIVER AT MACON, GA.

A station was established at Macon, Ga., January 21, 1893, by the United States Weather Bureau. Discharge measurements were begun by the United States Geological Survey in 1895, and a wire gage was established on the bridge of the Macon, Dublin and Savannah Railroad and was set on the same datum as the Weather Bureau gage. For a time gage-height records were maintained by the Geological Survey, as the Weather Bureau records were for a part of the year only and were discontinued altogether from June 30, 1897, to June 1, 1899. Since June 1, 1899, the Weather Bureau gage-height records have been taken continuously and have been furnished to the Geological Survey.

The channel is straight and without obstructions, except for one bridge pier. The banks are high and not subject to overflow. The bed of the river is soft and changeable.

Discharge measurements are made from the downstream side of the Fifth Street Bridge, an iron bridge of two 190-foot spans, located about 500 feet above the railroad bridge. The initial point for soundings is the end of the iron hand rail of the footway at the right bank on the downstream side.

The Weather Bureau gage is a heavy timber bolted to the downstream portion of the right-bank stone pier of the Central of Georgia Railway bridge. October 9, 1905, a standard chain gage was installed on the Fifth Street Bridge, on the outside of the latticed railing of the downstream footway at a point 85 feet from the right-bank end; length of chain, 40.83 feet. Bench marks were established as follows: (1) The top of the iron rim of the sidewalk 80 feet from the initial point for soundings; elevation, 34.42 feet. (2) The top of a cast-iron post at the end of the hand rail on the right bank, downstream side, of the Fifth Street Bridge; elevation, 37.37 feet. (3) The top of the downstream side of the capstone of the right-bank abutment of the Central of Georgia Railway bridge; elevation, 32.30 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 79-80; 19, iv, p 230; Bull 140, p 74; WS 15, p 44; 27, p 32; 36, pp 136-137; 48, p 155; 65, p 264; 83, p 107; 98, pp 94-95; 127, pp 66-67.

Discharge: Ann 18, iv, p 80; 19, iv, pp 230-231; Bull 140, p 75; WS 15, p 44; 27, p 44; 36, p 137; 48, p 155; 83, p 107; 65, p 265; 98, p 95; 127, p 67.

Discharge, low-water: Ann 18, iv, p 84.

Discharge, monthly: Ann 18, iv, pp 82-83; 19, iv, p 232; 20, iv, pp 161, 171; 21, iv, p 139; 22, iv, p 172; WS 75, p 75; 83, p 109; 98, p 97; 127, p 69.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: Bull 140, p 75; WS 11, pp 21-23; 15, p 44; 27, p 43; 36, p 137; 48, p 156; 65, p 265; 83, p 108; 98, pp 95-96; 127, p 68.

Hydrographs: Ann 18, iv, p 84; 19, iv, p 233; 20, iv, p 172; 21, iv, p 139; 22, iv, p 173.

Rainfall and run-off relation: Ann 20, iv, p 161.

Rating tables: Ann 18, iv, pp 81-82; 19, iv, p 232; WS 27, p 46; 39, p 444; 52, p 513; 65, p 321; 83, p 109; 98, p 96; 127, p 68.

Discharge measurements of Ocmulgee River at Macon, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 14	W. E. Hall	270	2,269	1.12	4.88	2,554
June 14	A. T. Mitchelson	209	1,350	.58	1.22	789
September 13	W. E Hall	195	1,090	.71	.71	772
September 28	M. R. Hall	127	786	.41	− .39	321
November 4 [a]	A. F. Murray	150	309	1.83	.46	565

[a] Made at different section.

Daily gage height, in feet, of Ocmulgee River at Macon, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.
1	2.7	2.1	4.2	2.2	2.9	2.1	3.0	0.8	0.7	0.6	0.7	0.8
2	2.3	2.1	3.9	2.2	2.4	1.8	6.7	.7	1.7	1.0	.6	.8
3	2.4	2.0	3.6	2.3	2.7	1.6	7.9	.8	2.4	1.2	.4	1.7
4	2.4	1.9	3.4	2.2	4.4	2.3	7.5	.6	2.2	2.9	.43	13.0
5	2.1	2.0	3.3	2.4	4.6	2.0	5.0	.4	2.2	2.0	.44	15.0
6	2.0	2.3	3.2	3.3	4.4	1.6	3.5	.0	1.5	1.5	.37	10.4
7	2.2	3.2	3.0	3.3	3.6	1.4	3.9	−.1	1.3	1.15	.32	6.7
8	2.7	6.2	3.0	3.0	3.8	1.3	4.5	−.1	.8	.75	.65	5.1
9	3.0	13.3	3.0	2.7	3.4	1.1	3.9	2.2	.4	.3	.62	6.9
10	2.4	11.4	3.7	3.3	3.0	1.0	3.2	4.4	.2	.27	.85	11.6
11	2.1	10.3	3.4	5.3	2.7	.8	3.7	3.5	−.1	.24	3.3	11.2
12	1.9	10.7	4.6	4.3	2.3	.7	6.7	3.4	−.2	.8	4.2	8.3
13	5.3	16.4	5.7	6.3	2.0	.9	6.6	10.6	−.3	1.3	3.4	6.7
14	9.0	15.4	5.0	4.6	1.8	1.7	8.2	7.4	.6	1.5	2.3	4.9
15	7.9	12.7	4.4	3.0	1.7	1.1	6.7	6.2	.2	1.2	1.85	6.6
16	5.0	10.2	3.9	4.1	2.4	1.8	3.3	6.3	.2	.7	1.7	5.9
17	4.1	7.7	3.5	3.3	4.0	3.8	2.7	4.2	.0	.45	1.35	5.4
18	3.8	6.4	3.3	3.1	2.5	2.2	2.3	3.5	−.2	.51	1.2	4.6
19	3.1	5.8	3.0	2.7	2.2	1.7	1.7	3.2	−.3	.43	1.12	4.1
20	3.0	5.3	3.0	2.4	1.8	1.4	1.6	1.9	−.4	.36	1.1	4.9
21	2.9	8.0	5.6	2.2	1.7	1.1	1.8	1.5	−.5	.34	.6	16.7
22	2.9	9.6	4.3	2.2	1.6	1.1	1.8	1.3	−.5	.26	.6	15.1
23	2.8	9.1	4.2	2.1	4.0	4.8	1.3	1.2	−.5	.16	.8	12.4
24	2.5	7.3	3.5	2.1	3.8	3.9	1.2	2.3	−.6	.18	.7	10.5
25	2.4	6.1	3.4	2.1	4.9	3.2	.9	2.9	−.3	.12	.6	9.4
26	2.2	5.6	3.3	2.0	4.4	2.3	1.2	2.3	−.2	.9	.6	7.9
27	1.9	5.0	3.2	2.0	3.5	1.8	2.1	1.5	−.3	1.3	.7	5.8
28	1.7	4.5	2.9	2.0	3.0	1.4	1.7	1.2	−.4	1.1	.9	4.7
29	2.0	.....	2.7	2.0	2.9	2.5	1.2	1.1	−.3	1.25	1.1	6.4
30	2.0	.....	2.5	2.2	2.9	2.5	1.1	.9	−.2	1.1	.9	5.8
31	2.0	.....	2.4	.....	2.5	.....	1.0	1.4	.....	.74	.....	4.8

Station rating table for Ocmulgee River at Macon, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−0.60	270	0.70	640	2.00	1,075	3.30	1,650
−.50	295	.80	670	2.10	1,110	3.40	1,700
−.40	320	.90	700	2.20	1,150	3.50	1,750
−.30	345	1.00	730	2.30	1,190	3.60	1,800
−.20	370	1.10	760	2.40	1,230	3.70	1,855
−.10	400	1.20	795	2.50	1,270	3.80	1,910
.00	430	1.30	830	2.60	1,315	3.90	1,965
.10	460	1.40	865	2.70	1,360	4.00	2,020
.20	490	1.50	900	2.80	1,405	4.20	2,130
.30	520	1.60	935	2.90	1,450	4.40	2,250
.40	550	1.70	970	3.00	1,500	4.60	2,370
.50	580	1.80	1,005	3.10	1,550	4.80	2,490
.60	610	1.90	1,040	3.20	1,600	5.00	2,610

The above table is based on discharge measurements made during 1903–1905. It is well defined between gage heights −0.4 foot and 5 feet. For gage heights above 5 feet the discharge has been estimated from 1903 measurements.

Estimated monthly discharge of Ocmulgee River at Macon, Ga., for 1905.

[Drainage area, 2,425 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,170	970	1,599	0.659	0.760
February	23,980	1,040	5,307	2.19	2.28
March	2,940	1,230	1,816	.749	.864
April	3,315	1,075	1,484	.612	.683
May	2,460	935	1,539	.635	.732
June	2,400	640	1,072	442	.493
July	4,560	700	1,878	.774	.892
August	6,830	400	1,466	.605	.698
September	1,230	270	533	.220	.246
October	1,450	466	696	.287	.331
November	2,130	526	810	.334	.373
December	25,240	670	5,580	2.30	2.65
The year	25,240	270	1,982	.817	11.00

ALCOVY RIVER NEAR STEWART, GA.

This station was established September 16, 1905, by M. R. Hall. It is located at a wooden wagon bridge known as "Waters Bridge," about 15 miles south of Covington, Ga., and 5 miles from Stewart, Ga. The bridge is below the mouth of Bear Creek and about 4 miles from the mouth of the river. The station is important because it is a short distance below a large amount of fall at the old Newton factory site.

The channel curves to the left bank about 45° in 300 feet above the station and is straight for 1,000 feet below the station. The right bank is high and will not overflow. The left bank may overflow about 200 feet at high floods. The channel above and below appears to contain much sand, which is shifting, though the bed is mostly rock in the part under the right span of the bridge, to which nearly all of the flow is confined at lowest stage of water.

Discharge measurements are made from the bridge of three spans of about 50 feet each.

A vertical staff gage is attached to a birch tree at the right edge of the water, 12 feet upstream from the bridge. It is read once each day by A. J. White. The bench mark is a cross and circles cut on a solid rock outcrop at the right edge of the water, just under the downstream side of the bridge; elevation, 2.36 feet above the datum of the gage.

Discharge measurements of Alcovy River near Stewart, Ga., in 1905 and 1906.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1905.		*Feet.*	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
September 16	M. R. Hall	36	48	1.00	1.54	48
September 16	do	36	48	1.00	1.55	48
November 24	do	54	61	1.73	2.03	106
November 24	do	54	62	1.68	2.05	105
1906.						
January 13	W. E. Hall	73	255	2.27	4.80	580
January 13	do	73	259	2.32	4.82	600

Daily gage height, in feet, of Alcovy River near Stewart, Ga., for 1905.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		1.65	1.95	2.05	17	1.75	1.65	2.1	4.2
2		1.6	1.8	2.05	18	1.7	1.7	2.1	4.0
3		1.6	1.8	6.25	19	1.7	1.7	2.1	3.8
4		1.7	1.6	6.2	20	1.65	1.7	2.1	5.8
5		1.75	1.65	7.5	21	1.6	1.7	2.0	7.5
6		2.0	1.7	7.0	22	1.6	1.7	2.05	7.0
7		2.05	2.05	6.0	23	1.6	1.7	2.0	7.8
8		1.75	1.75	5.3	24	1.55	1.6	2.0	7.0
9		1.75	1.8	6.3	25	1.55	1.65	2.0	6.0
10		1.65	2.1	5.2	26	1.5	1.8	2.1	5.5
11		2.0	3.3	5.2	27	1.5	1.85	2.2	4.8
12		1.8	2.8	5.8	28	1.5	1.85	2.2	4.4
13		1.95	2.8	6.0	29	1.45	1.95	2.05	4.4
14		2.05	2.7	5.2	30	1.5	1.9	2.15	4.2
15		2.0	2.45	4.8	31		1.9		4.2
16	1.55	1.95	2.25	4.2					

Station rating table for Alcovy River near Stewart, Ga., from September 16 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	34	2.90	220	4.30	474	5.70	824
1.50	44	3.00	236	4.40	496	5.80	852
1.60	55	3.10	252	4.50	518	5.90	880
1.70	66	3.20	268	4.60	540	6.00	910
1.80	77	3.30	284	4.70	564	6.20	970
1.90	88	3.40	300	4.80	588	6.40	1,030
2.00	100	3.50	318	4.90	612	6.60	1,090
2.10	112	3.60	336	5.00	636	6.80	1,150
2.20	124	3.70	354	5.10	662	7.00	1,210
2.30	136	3.80	372	5.20	688	7.20	1,274
2.40	150	3.90	392	5.30	714	7.40	1,338
2.50	164	4.00	412	5.40	740	7.60	1,402
2.60	178	4.10	432	5.50	768	7.80	1,466
2.70	192	4.20	452	5.60	796	8.00	1,530
2.80	206						

The above table is based on six discharge measurements made during 1905 and 1906. It is fairly well defined between gage heights 1.4 feet and 5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Alcovy River near Stewart, Ga., for 1905.

[Drainage area, 395 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
September 16-30	72	39	52.9	0.134	0.075
October	106	55	76.5	.194	.224
November	284	55	117	.296	.330
December	1,466	106	766	1.94	2.24

YELLOW RIVER NEAR STONE MOUNTAIN, GA.

This station was established in 1905 for the purpose of making a series of miscellaneous measurements. It is located at the single-span bridge known as Sextons Bridge, about 6 miles east from Stone Mountain, Ga., and 2½ miles above the old Annistown factory site, where there is a large amount of fall.

The section is good for measurements, but the bed is sandy and shifting.

Discharge measurements are made from the bridge.

Gage heights are determined directly from the bench mark, which is the top of the downstream end of the floor beam at the middle of the span; elevation, 21.00 feet above the datum of the assumed gage.

Discharge measurements of Yellow River near Stone Mountain, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 28	B. S. Drane	45	107	.90	1.96	96
November 23	M. R. Hall	39	54	1.06	1.78	57

APALACHEE RIVER NEAR BUCKHEAD, GA.

This station was established February 13,1901, by M. R. Hall. It is located at the iron wagon bridge over Apalachee River, about 3½ miles north of Buckhead, Ga.

At ordinary stages the channel is about 80 feet wide, and it is only slightly curved above and below the bridge. The bed of the stream is part rock and part sand. The current is moderately swift and is somewhat broken and irregular on account of ruins of old pier bases about 50 feet upstream. The right bank is low for a distance of 400 feet and will overflow at a gage height of 10 feet. The low portion is thickly covered with trees and a brushy growth, which will greatly retard the flood water passing over it. The left bank is high and will not overflow, except to a short distance up the steep slope.

Discharge measurements are made from the downstream side of the bridge, the initial point being the outside of the iron pier at the left bank, downstream side. The bridge is a single span 103 feet long, supported by tubular piers. Its trestle approaches are about 500 feet long on the right bank and about 100 feet on the left.

The original gage consisted of two sections; the first section, reading from 0 to 10 feet, was fastened to a small ash tree on the left bank about 100 feet below the bridge. The second section, reading from 6 to 20 feet, was nailed to the upstream post of the last wooden bent next to the iron bridge, on the right bank. March 22, 1905, a standard chain gage was attached to the upstream side of the bridge, in the third panel from the right bank; length of the chain, 30.70 feet. The gage was read once each day by G. A. J. Adams, except for three months during low water when readings were made twice each day. Bench marks were established as follows: (1) The top of the iron pier from the right bank, downstream side; elevation, 25.00 feet. (2) The top of the downstream end of the first floor beam from the right bank; elevation, 25.50 feet. (3) A copper plug set in solid rock 10 feet west of the upstream tubular pier on the right bank and 3 feet upstream from the line of the upper edge of the bridge; elevation, 3.73 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 258; 83, p 104; 98, pp 90-91; 127, pp 72-73.
Discharge: 65, p 259; 83, p 104; 98, p 91; 127, p 73.
Discharge monthly: 75, pp 66, 74; 83, p 106; 98, p 92; 127, p 75.
Gage heights: 65, p 259; 83, p 105; 98, p 91; 127, p 74.
Rating tables: 65, p 321; 83, p 106; 98, p 92; 127, p 74.

Discharge measurements of Apalachee River near Buckhead, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 23	M. R. Hall	85	233	1.62	2.30	379
May 11	do	80	215	1.27	1.74	273
Jnue 8	do	79	187	1.19	1.44	223
June 8	do	79	186	1.12	1.41	208
September 8	do	75	157	1.00	1.13	157
September 8	do	75	154	1.02	1.13	157
October 30	do	68	117	.83	.80	97
October 31	do	79	166	1.11	1.38	185
November 15	F. A. Murray	77	172	1.06	1.39	183

Daily gage height, in feet, of Apalachee River near Buckhead, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	1.8	2.8	2.0	2.4	2.0	2.8	1.5	1.05	0.86	1.3	1.4
2	1.8	1.9	2.7	1.9	2.1	1.8	6.4	1.4	2.7	[a] .52	1.15	1.55
3	2.2	1.9	2.6	1.8	2.2	1.95	9.0	1.35	3.1	.62	1.1	4.6
4	2.0	1.8	2.5	2.0	3.5	2.1	3.3	1.3	2.1	1.05	1.1	13.7
5	1.9	1.9	2.5	2.2	3.3	1.65	2.0	1.25	1.72	1.45	1.1	10.5
6	1.8	2.0	2.4	2.2	3.4	1.85	2.3	1.0	1.4	1.3	[a] .71	5.5
7	2.2	2.5	2.4	2.25	2.4	1.65	5.4	[a] .4	1.15	1.15	1.35	2.95
8	2.1	3.4	2.3	2.25	2.5	1.55	10.2	1.0	1.1	1.1	1.3	3.2
9	2.1	4.5	2.5	2.25	2.25	1.5	5.5	1.95	1.0	[a] .51	1.25	6.4
10	2.0	5.6	2.5	2.25	2.2	1.45	3.0	4.3	.92	1.25	1.4	9.7
11	2.0	6.2	2.4	2.3	2.2	1.35	2.65	4.4	[a] .65	1.3	2.6	9.0
12	2.1	7.8	2.6	2.25	1.9	.85	2.7	4.4	.91	1.3	2.3	5.0
13	4.7	9.0	2.7	2.25	1.8	1.35	2.75	5.3	.94	1.25	1.95	4.2
14	5.0	11.4	3.1	2.2	1.7	1.4	2.6	3.6	.88	1.25	1.6	3.6
15	4.2	9.0	2.8	2.2	1.5	1.35	2.35	4.7	.95	1.2	1.55	3.6
16	3.0	5.3	2.7	2.2	2.1	1.35	1.9	3.4	.92	[a] .68	1.45	4.7
17	2.6	4.2	2.5	1.9	2.2	2.05	1.5	2.7	.88	1.2	1.45	3.8
18	2.2	3.7	2.4	2.2	2.0	1.5	1.75	7.6	[a] .52	1.15	1.45	3.0
19	2.3	3.3	2.2	2.0	1.8	1.0	1.7	2.7	.85	1.15	1.35	2.7
20	2.3	3.3	1.9	2.0	1.7	1.5	3.6	2.3	.73	1.1	1.0	4.2
21	2.2	5.6	2.4	1.9	1.5	1.35	1.95	1.65	.66	1.1	1.5	11.0
22	2.1	7.3	2.5	2.0	1.2	3.8	1.7	1.9	.75	.92	1.4	14.0
23	2.0	6.0	2.4	1.9	2.1	4.6	1.7	1.8	.82	[a] .59	1.4	9.9
24	1.9	4.8	2.35	1.8	3.3	3.4	1.0	1.7	.78	1.15	1.35	5.7
25	1.9	3.4	2.3	1.9	4.7	3.3	2.15	1.6	[a] .41	1.1	1.3	4.2
26	1.8	3.2	2.25	2.0	4.7	2.2	2.1	1.55	.63	1.15	1.3	3.7
27	1.8	3.0	2.2	1.9	3.1	1.85	1.75	1.4	.6	1.15	1.35	3.4
28	1.9	2.9	2.2	1.9	2.5	3.1	1.6	[a] .78	.67	1.1	1.65	3.8
29	1.9	.....	2.2	1.8	2.9	2.35	1.5	1.2	.65	1.1	1.55	4.2
30	1.8	.....	2.2	1.7	3.1	1.95	1.4	1.1	.65	[a] .85	1.4	4.0
31	1.8	.....	2.0	.....	2.2	.....	1.65	1.0	.....	1.35	.....	4.0

[a] During low water the Monday gage heights are lower than natural flow on account of storing water on Sundays at High Shoals Factory, 25 miles above the station.

Station rating table for Apalachee River near Buckhead, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	44	2.10	358	3.70	820	6.60	1,690
.50	54	2.20	384	3.80	850	6.80	1,750
.60	66	2.30	410	3.90	880	7.00	1,810
.70	78	2.40	436	4.00	910	7.20	1,870
.80	92	2.50	464	4.20	970	7.40	1,930
.90	108	2.60	492	4.40	1,030	7.60	1,990
1.00	124	2.70	520	4.60	1,090	7.80	2,050
1.10	142	2.80	550	4.80	1,150	8.00	2,110
1.20	160	2.90	580	5.00	1,210	8.50	2,260
1.30	180	3.00	610	5.20	1,270	9.00	2,410
1.40	200	3.10	640	5.40	1,330	9.50	2,560
1.50	220	3.20	670	5.60	1,390	10.00	2,710
1.60	242	3.30	700	5.80	1,450	11.00	3,010
1.70	264	3.40	730	6.00	1,510	12.00	3,310
1.80	286	3.50	760	6.20	1,570	13.00	3,610
1.90	310	3.60	790	6.40	1,630	14.00	3,910
2.00	334						

The above table is based on discharge measurements made during 1903-1905. It is fairly well defined between gage heights 0.8 foot and 7.3 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Apalachee River near Buckhead, Ga., for 1905.

[Drainage area, 440 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,210	286	423	0.961	1.11
February	3,130	286	1,074	2.44	2.54
March	640	310	448	1.02	1.18
April	410	264	346	.786	.877
May	1,120	160	469	1.07	1.23
June	1,090	100	345	.784	.875
July	2,770	124	624	1.42	1.64
August	1,990	[a] 44	462	1.05	1.21
September	640	[a] 45	145	.330	.368
October	210	[a] 55	139	.316	.364
November	492	[a] 79	209	.475	.530
December	3,910	200	1,371	3.12	3.60
The year	3,910	[a] 44	505	1.15	15.52

[a] See note to gage-height table, p. 64.

OCONEE RIVER NEAR GREENSBORO, GA.

This station was established July 25, 1903, by M. R. Hall. It is located at the new wagon bridge, about 5 miles west of Greensboro, on the road to Madison, Ga.

Ordinarily the river is about 120 feet wide. The bed is sandy and shifting. The channel is nearly straight, and the current is regular. The right bank is high and rocky, with the exception of a low bench under the bridge and approach. The left bank is low, and will overflow at a gage height of about 12 to 15 feet to the end of the approach, a distance of about 600 feet, and extreme high water may pass beyond the end of the approach.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the end of the iron trestle on the right bank, downstream side. The bridge is of two spans. The first one from the right bank is 80 feet long, and is not over the water except at time of floods. The main span over the river is 144 feet long. There are also 52 feet of iron trestle and about 40 feet of wooden trestle on the right bank and 253 feet of iron trestle and about 325 feet of wooden trestle on the left bank.

A standard chain gage is fastened to the lower chord of the downstream side of the bridge 163 to 165 feet from the initial point for soundings; length of chain, 38.73 feet. The gage is read once each day by M. A. Stevens, except during three months of the low-water period, when it is read twice each day. Bench marks were established as follows: (1) The top of the downstream end of the second floor beam from the right-bank pier; elevation, 36.00 feet. (2) A copper plug set in the rock under the upstream side of the bridge opposite a point 84 feet from the initial point for soundings; elevation, 13.55 feet. (3) Point on a hickory tree 26 feet downstream from the end of the wooden trestle on the right bank; elevation, 33.15 feet. (4) The concrete foundation under the iron post below the initial point for soundings; elevation, 27.58 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 88-89; 127, pp 75-76.
Discharge: 98, p 89; 127, p 76.
Discharge, monthly: 127, p 78.
Gage heights: 98, p 90; 127, p 77.
Rating table: 127, p 77.

Discharge measurements of Oconee River near Greensboro, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet*
March 23	M. R. Hall	117	468	1.77	2.32	828
May 11	do	116	469	1.89	2.48	886
June 8	do	116	326	1.59	1.36	519
June 8	do	116	317	1.62	1.30	514
September 7	do	91	248	1.36	.77	338
September 7	do	91	252	1.31	.74	331
October 30	do	91	213	1.54	.74	328
October 30	do	91	216	1.5	.73	325
November 25	F. A. Murray	111	253	1.61	1.03	407

Daily gage height, in feet, of Oconee River near Greensboro, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	1.9	3.2	2.1	2.0	2.3	2.2	1.4	1.25	0.4	0.7	1.3
2	2.1	2.0	3.1	2.1	2.0	2.0	2.0	1.3	1.85	.15	.65	1.1
3	2.0	2.0	2.9	1.9	2.6	2.0	6.8	1.3	1.3	.85	.7	8.1
4	1.9	2.1	2.8	2.0	4.1	1.8	2.8	1.0	1.1	1.55	.65	11.6
5	1.7	2.2	2.8	2.1	5.4	1.7	2.1	.7	1.4	1.3	.55	13.3
6	1.5	2.4	2.7	2.1	4.5	1.7	3.0	.4	1.15	1.15	.6	11.2
7	2.0	2.0	2.7	2.4	5.6	1.6	6.0	.3	.9	.85	.7	4.0
8	2.7	4.0	2.6	2.2	4.0	1.4	11.2	.6	.85	.8	.7	3.8
9	2.4	4.8	2.6	2.2	3.6	1.3	5.0	1.4	.8	.9	.95	8.1
10	2.0	6.9	2.7	2.0	3.0	1.1	3.1	4.3	.65	1.05	1.2	11.8
11	1.9	7.2	2.6	2.0	2.5	1.1	2.8	3.4	.40	1.25	2.55	12.4
12	1.5	8.0	2.6	2.1	2.2	1.2	5.1	4.4	.9	.95	2.0	8.2
13	3.0	11.4	2.7	2.0	2.0	1.2	4.4	4.6	1.1	1.25	1.85	5.4
14	8.5	12.5	3.2	2.0	1.9	1.5	4.3	4.3	.95	1.2	1.7	3.4
15	6.2	10.7	3.0	1.9	1.6	1.5	3.6	5.4	.95	.9	1.35	4.2
16	4.3	6.2	2.6	2.0	2.0	1.6	2.9	5.6	.8	.85	1.25	4.5
17	3.7	4.9	2.6	2.0	2.0	2.2	2.1	5.6	.65	1.1	1.2	3.9
18	2.7	4.0	2.4	1.9	2.0	2.0	2.0	4.6	.35	1.05	1.05	3.4
19	2.5	3.7	2.4	1.8	1.7	1.8	1.7	2.2	.8	1.05	1.0	3.2
20	2.5	4.2	2.4	1.8	1.5	1.8	1.8	2.4	.8	1.05	1.05	4.0
21	2.5	8.1	2.8	1.7	1.6	1.7	1.8	1.7	.6	.95	1.15	12.7
22	2.3	9.6	2.7	1.7	1.6	1.6	1.7	1.7	.6	.50	1.25	14.0
23	2.3	10.3	2.4	1.8	2.0	2.7	1.4	1.5	.55	.45	1.3	10.5
24	2.1	7.0	2.4	1.8	7.5	2.8	1.6	1.7	.35	.7	1.3	6.6
25	1.9	5.2	2.3	1.7	6.5	2.4	1.9	3.4	.20	.75	1.3	5.8
26	1.7	4.2	2.3	1.7	4.1	2.0	1.9	4.4	.50	.8	1.35	4.6
27	1.7	3.5	2.1	1.7	3.2	1.5	1.8	2.2	.45	.8	1.4	3.6
28	1.5	3.2	2.3	1.7	2.8	1.5	1.5	1.75	.4	.75	1.8	3.4
29	1.8	.....	2.3	1.6	2.6	1.8	1.4	1.6	.45	.7	1.4	4.0
30	1.7	.....	2.2	1.7	2.5	2.0	1.2	1.15	.5	.55	1.3	4.0
31	1.9	.....	2.1	.....	2.3	.....	1.0	1.1	.....	.6	.....	3.8

NOTE.—On account of a daily fluctuation caused by developed powers above two readings a day were made during the last four months. The low days during this period can be attributed to stored water, and do not represent the natural flow.

Station rating table for Oconee River near Greensboro, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	195	1.80	655	3.40	1,250	6.00	2,550
.30	220	1.90	690	3.50	1,295	6.20	2,660
.40	245	2.00	725	3.60	1,340	6.40	2,770
.50	270	2.10	760	3.70	1,385	6.60	2,880
.60	295	2.20	795	3.80	1,430	6.80	3,000
.70	320	2.30	830	3.90	1,475	7.00	3,120
.80	345	2.40	865	4.00	1,520	7.20	3,240
.90	375	2.50	900	4.20	1,620	7.40	3,360
1.00	405	2.60	935	4.40	1,720	7.60	3,480
1.10	435	2.70	970	4.60	1,820	7.80	3,610
1.20	465	2.80	1,010	4.80	1,920	8.00	3,740
1.30	495	2.90	1,050	5.00	2,020	8.50	4,065
1.40	525	3.00	1,090	5.20	2,120	9.00	4,410
1.50	555	3.10	1,130	5.40	2,220	9.50	4,760
1.60	585	3.20	1,170	5.60	2,330	10.00	5,110
1.70	620	3.30	1,210	5.80	2,440	10.50	5,465

The above table is based on the discharge measurements made during 1903–5. It is well defined between gage heights 0.7 foot and 4 feet. The table has been extended beyond these limits. Above gage height 10.4 feet the rating curve is a tangent, the difference being 75 per tenth.

Estimated monthly discharge of Oconee River near Greensboro, Ga., for 1905.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,065	555	970	0.882	1.02
February	6,965	690	2,497	2.27	2.36
March	1,170	760	937	.852	.982
April	865	585	698	.635	.708
May	3,420	555	1,156	1.05	1.21
June	1,010	435	646	.587	.655
July	5,990	405	1,195	1.09	1.26
August	2,330	220	978	.889	1.02
September	672	195	348	.316	.353
October	570	185	372	.338	.390
November	918	282	470	.427	.476
December	8,090	435	3,086	2.81	3.24
The year	8,090	185	1,113	1.01	13.67

NOTE.—For minimum flow see note to gage-height table, p. 67.

OCONEE RIVER AT FRALEYS FERRY, NEAR MILLEDGEVILLE, GA.

This station is located at Fraleys Ferry, about 6 miles above Milledgeville, Ga., and about 4 miles below the mouth of Little River, for the purpose of making a series of miscellaneous measurements. This point, being above the dam at Milledgeville, has a nearly natural flow, being but slightly affected by the dams a great distance upstream.

The channel is straight for some distance above and below the station. The current is moderate or slow at low stages. The bed is sandy and changing, but the rock shoals below will probably control the water level at the station.

Discharge measurements are made from the ferryboat or from a small boat controlled by the ferry cable along which the distances are marked. Measurements can be made at low and medium stages only, as the current soon becomes too great for safety in boat measurements.

During a short period in October and November, 1905, gage-height records were maintained by Charles F. Howe, who put in a temporary gage and has furnished the records to the Geological Survey. These gage heights, which are the means of four readings daily, and the discharge measurements which were made form a much more accurate basis for estimating the flow for the period which they cover than the records for the station at Milledgeville, 6 miles below. The bench mark is a nail driven horizontally into an ash tree on the right bank about 200 feet above the ferry; elevation, 10.00 feet above the datum of the gage.

Discharge measurements of Oconee River at Fraleys Ferry, near Milledgeville, Ga., in 1904 and 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
1904.						
June 29	W. E. Hall	270	1,310	0.79	4.90	1,030
September 20	M. R. Hall	270	1,108	.50	4.35	547
1905.						
November 24	F. A. Murray	272	1,551	.63	5.02	985

Daily gage height, in feet, of Oconee River at Fraleys Ferry, near Milledgeville, Ga., for 1905.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1		4.85	12		6.0	22	4.65	
2		4.85	13		5.6	23	4.55	
3		4.75	14		5.2	24	4.55	
4		4.7	15			25	4.45	
5		4.7	16			26	4.8	
6		4.6	17			27	4.8	
7		4.65	18			28	4.85	
8		4.8	19			29		
9		4.85	20	4.7		30	4.8	
10		5.0	21	4.7		31	4.85	
11		6.0						

OCONEE RIVER AT MILLEDGEVILLE, GA.

This station was established August 22, 1903, by M. R. Hall, though several discharge measurements were made before that time. The first one was made October 19, 1895, by C. C. Babb. The bench mark to which the present gage is referred was used to get the water height at the time of each of these measurements. The station is located at the iron highway bridge in the eastern part of Milledgeville, Ga.

At low water the river is about 300 feet wide, including two piers, and often a sand bar of considerable extent in the third span. This bar sometimes practically stops the third-span channel, leaving the river about 200 feet wide. The bed is sandy and shifting and the water is shallow and swift. These conditions are unfavorable to accurate measurements as well as a constant rating. The channel is only slightly curved. Both banks are high and will not overflow.

Discharge measurements are made from the downstream side of the bridge, and the initial point for soundings is the end of the iron bridge at the right bank, downstream side. The bridge consists of four spans, 100 feet, 150 feet, 150 feet, and 80 feet long, respectively, beginning at the right-bank end, and short wooden trestles about 25 feet long at each end.

A standard chain gage, established in August, 1904, is fastened to the intermediate posts on the upstream side of the third panel of the second span from the right bank. The gage is read once each day by J. A. Brooks, who is paid by the United States Weather Bureau. The bottom of the gage box is 43.80 feet above the datum of the gage, and the length of the chain is 45.80 feet. The bench mark is the top of the third floor beam from the pier on the east bank, downstream end; elevation, 39.00 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (WS=Water-Supply Paper; Bull=Bulletin):

Description: WS 98, pp 87-88; 127, pp 78-79.
Discharge: Bull 140, pp 73-74; WS 49, p 207; 83, p 113; 98, p 88; 127, p 79.
Discharge, monthly: WS 127, p 81.
Gage heights: WS 98, p 88; 127, p 80.
Rating table: WS 127, p 80.

Discharge measurements of Oconee River at Milledgeville, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 28	M. R. Hall	289	726	2.57	2.73	1,867
June 9	do	256	547	1.95	1.64	1,064
September 14	W. E. Hall	282	571	1.53	1.20	874
September 15	do	281	511	1.39	.95	712
November 23	F. A. Murray	283	617	1.35	1.16	856

Daily gage height, in feet, of Oconee River at Milledgeville, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.1	3.6	2.6	3.0	2.6	2.6	1.3	1.3	0.3	0.93	1.2
2	2.4	2.1	3.5	2.4	2.8	2.3	3.3	1.4	5.4	.7	1.0	1.1
3	2.3	2.1	3.3	2.4	4.0	2.2	6.4	1.2	4.4	.6	.92	2.3
4	2.5	2.1	3.1	2.4	4.0	2.1	5.4	1.0	3.4	1.6	.8	8.7
5	2.2	2.0	3.1	2.5	4.6	2.3	2.9	1.0	2.9	2.5	.77	11.4
6	2.0	2.3	3.0	2.9	4.7	2.0	2.3	.8	1.9	1.5	.75	11.6
7	2.4	3.0	2.9	3.1	3.7	2.0	3.0	.7	1.5	1.3	.7	5.4
8	2.6	4.9	2.9	2.9	5.2	1.8	8.0	1.1	1.2	1.15	.8	3.4
9	2.8	11.0	2.9	2.8	4.3	1.6	8.9	.9	1.0	.8	1.0	3.8
10	2.6	9.7	3.3	4.5	3.6	1.5	4.2	4.4	1.0	.87	1.2	9.6
11	2.4	8.5	3.3	4.3	3.1	1.4	3.6	5.0	1.0	.73	2.3	10.8
12	2.6	10.3	4.5	3.7	2.8	1.4	4.5	4.0	.9	1.0	3.7	10.2
13	3.3	21.0	6.2	5.9	2.5	1.5	4.8	6.8	.8	1.1	2.5	6.1
14	6.3	19.2	4.5	3.9	2.2	1.6	3.6	6.5	1.2	1.3	1.9	4.1
15	7.0	14.7	4.3	3.1	2.0	1.6	3.8	4.9	.9	1.1	1.7	6.1
16	5.0	10.0	3.7	3.2	2.0	1.5	2.7	4.9	1.0	.98	1.5	6.2
17	3.8	6.5	3.4	3.1	3.2	1.5	2.2	4.0	.8	1.1	1.3	5.0
18	3.0	5.3	3.1	2.8	2.7	2.5	1.9	13.0	.8	.82	1.2	4.2
19	2.8	4.6	3.1	2.7	2.4	2.1	1.8	5.7	.7	.93	1.0	3.5
20	2.9	4.3	3.0	2.6	2.1	1.9	1.7	2.7	.7	.9	1.0	4.4
21	2.9	7.8	4.2	2.4	1.9	1.7	2.1	2.1	.8	.85	1.1	18.8
22	2.7	10.2	4.7	2.4	2.2	2.5	1.8	1.8	.6	.7	1.2	18.1
23	2.5	9.6	3.6	2.5	3.3	4.7	1.7	1.8	.5	.63	1.1	15.1
24	2.4	8.6	3.2	2.4	6.6	4.3	1.5	2.1	.4	.68	1.1	10.5
25	2.4	6.3	3.1	2.3	7.3	3.2	2.1	3.4	.5	.63	1.3	6.5
26	2.2	4.9	3.0	2.4	6.2	2.8	2.1	2.8	.5	.87	1.1	5.0
27	2.0	4.3	3.0	2.5	4.9	2.1	1.9	3.6	.4	.87	1.1	4.3
28	2.0	3.9	2.9	2.5	3.5	2.0	1.7	2.0	.1	1.03	1.2	3.9
29	1.9	.....	2.7	2.3	3.1	2.2	1.5	1.6	.2	.95	1.6	6.6
30	2.0	.....	2.6	3.1	3.0	2.7	1.2	1.4	.4	.92	1.3	6.1
31	1.8	.....	2.6	.....	3.5	.....	1.5	1.2	.....	.88	.....	4.8

NOTE.—As this station is just below a mill, estimates based on the gage height can not be considered even approximately correct. From October 6 to November 6 an attempt was made to obtain a proper mean gage height by making six readings daily. For the rest of the time only one reading was made.

OCONEE RIVER AT DUBLIN, GA.

A station was established by the United States Weather Bureau in 1894 at Dublin, Ga., about 60 miles above the junction of the Oconee with the Ocmulgee. Records were kept, with the exception of the summer months of 1896, until April 30, 1897, when the station was discontinued. In 1898 discharge measurements were commenced by the United States Geological Survey, and February 11 an observer was employed to read the gage. October 15, 1898, the Weather Bureau again adopted the station and has maintained the gage and furnished gage heights to the Geological Survey continuously since that time.

The ordinary width of the river is about 235 feet. At a gage height of about 20 feet the left bank begins to overflow, and it is practically covered to the end of the approach at 25 feet. This ground is thickly covered with a brushy growth, which will no doubt cause the velocity of the water overflowing it to be small. The right bank does not overflow. The bed of the stream is of loose rock, sand, and gravel. The channel is straight and the current is swift and fairly uniform, except where it is broken by the three bridge piers.

Discharge measurements are made from the iron highway bridge, which consists of a draw span between two other spans of 75 feet each. The total length of the bridge proper is 320 feet. On the left bank, which is low, there are 1,100 feet of iron-frame trestle

approach. There is also a short trestle on the right bank, which is high. The initial point for soundings is the end of the bridge at the right bank, on the upstream side.

The gage is a heavy timber bolted to the downstream side of the center pier of the Wrightsville and Tennille Railroad bridge, 500 feet downstream from the highway bridge.

The bridge is a drawbridge, and the pier to which the gage is attached is the circular center pier of the draw span. A secondary sloping gage, reading from −1.6 to + 1.9 feet, is attached to a solid rock on the right bank about 25 feet above the railroad bridge. The gage is read once each day by R. F. Mathis. Bench marks were established as follows: (1) The top of the upstream end of the floor beam on top of the first tubular pier of the wagon bridge from the right bank; elevation, 41.30 feet. (2) A point on the fifth step from the bottom at the south entrance of the court-house, 6 inches from the east end of the step; elevation, 82.51 feet. (3) The top of the granite water table 2½ feet west of the southeast corner of the court-house; elevation, 80.97 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 227-228; WS 15, p 42; 27, p 31; 36 p 133; 48, p 152; 65, p 259; 83, p 96; 98, pp 84-85; 127, pp 81-82.

Discharge: WS 15, p 42; 27, p 44; 36, p 133; 48, p 152; 65, p 259; 83, p 97; 98, p 85; 127, p 83.

Discharge, monthly: Ann 20, iv, pp 161, 170; 21, iv, p 136; 22, iv, p 164; WS 75, pp 68, 75; 83, p 98; 98, p 87; 127, p 85.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: WS 11, pp 19-20; 15, p 42; 27, p 43; 36, p 134; 48, p 153; 65, p 260; 83, p 97; 98, pp 85-86; 127, p 84.

Hydrographs: Ann 20, iv, p 170; 21, iv, p 137; 22, iv, p 164; WS 75, p 68.

Rainfall and run-off relation: Ann 20, iv, p 161.

Rating tables: WS 27, p 46; 39, p 444; 52, p 513; 65, p 321; 83, p 98; 98, p 86; 127, p 84.

Discharge measurements of Oconee River at Dublin, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 15	W. E. Hall	260	2,760	3.00	7.03	8,283
April 25	F. A. Murray	210	1,166	2.26	1.14	2,631
April 25	do	226	1,187	2.12	1.11	2,518
June 13	A. T. Mitchelson	194	872	1.36	− .60	1,187
June 13	do	215	789	1.51	− .60	1,192
July 31	F. A. Murray	192	726	1.65	− .62	1,201
November 6	do	196	661	1.40	− .97	929
November 6	do	204	683	1.29	− .98	882
November 9	do	204	678	1.26	− .99	85[illegible]

Daily gage height, in feet, of Oconee River at Dublin, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	0.7	5.4	1.8	1.4	2.2	0.8	−0.7	−0.5	−1.2	−0.7	−0.3
2	1.7	.7	4.4	1.7	1.7	1.6	1.3	− .6	− .3	−1.2	− .6	− .4
3	1.1	.7	3.9	1.7	1.9	1.2	.9	− .8	1.2	−1.3	− .6	− .2
4	1.0	.6	3.6	1.6	2.5	.9	3.3	− .8	2.8	−1.2	− .8	.5
5	.4	.6	3.3	1.5	3.9	.6	4.3	− .9	1.8	−1.1	− .9	4.0
6	.4	.7	3.0	1.6	4.0	.6	2.2	−1.0	1.6	.4	− .9	5.8
7	1.2	1.1	2.8	1.8	4.2	.6	.9	−1.1	.8	− .1	− .9	6.4
8	1.5	1.8	2.7	2.3	3.3	.1	1.1	−1.0	.1	− .4	− .9	6.6
9	1.5	3.8	2.5	2.1	3.3	− .1	4.4	−1.0	− .3	− .6	− .9	5.4
10	1.6	5.9	2.8	2.1	3.3	− .3	5.5	− .8	− .5	− .6	− .8	3.4
11	1.5	7.7	3.3	3.1	2.4	− .4	5.0	.1	− .7	− .8	− .4	5.5
12	1.5	8.8	4.3	3.9	1.8	− .5	3.0	3.0	− .8	− .9	.0	6.4
13	1.1	12.5	5.8	3.7	1.3	− .5	3.0	3.0	− .7	− .9	1.4	6.8
14	1.7	14.5	7.3	5.0	.9	− .5	3.8	4.2	− .6	− .7	1.2	7.1
15	4.2	16.8	7.3	5.3	.6	− .5	2.7	5.0	− .7	− .7	.2	7.0
16	5.0	19.5	6.6	4.0	.3	− .1	2.3	4.0	− .6	− .6	.1	6.7
17	4.5	19.5	5.4	3.3	.6	− .3	1.4	3.8	− .7	− .7	− .1	6.0
18	3.3	18.0	4.4	2.9	1.2	− .3	.6	2.8	− .8	− .8	− .2	5.5
19	2.6	16.0	3.5	2.2	1.2	− .3	.2	4.9	− .9	− .9	− .4	4.2
20	1.6	13.8	3.0	2.0	.8	+ .3	− .1	5.8	− .9	− .9	− .5	3.0
21	1.6	10.5	3.8	1.6	.4	− .1	− .2	3.0	−1.0	− .9	− .5	6.3
22	1.6	8.5	4.8	1.6	.2	− .2	− .3	1.0	−1.1	− .9	− .6	8.7
23	1.6	8.8	5.2	1.6	.4	+ .2	− .2	.5	−1.1	−1.0	− .7	9.5
24	1.4	9.4	4.3	1.4	1.9	1.4	− .3	− .1	−1.0	−1.1	− .5	11.0
25	1.2	9.8	3.8	1.2	4.0	2.0	− .4	.1	−1.2	−1.1	− .2	13.5
26	1.2	10.3	3.3	1.1	5.5	1.7	− .5	1.2	−1.2	−1.0	− .4	14.6
27	.9	9.8	2.9	1.3	5.8	1.0	+ .3	1.3	−1.2	−1.0	− .4	14.0
28	.7	7.5	2.6	1.3	4.3	.4	− .1	1.5	−1.2	− .8	− .5	12.0
29	.6	.....	2.3	1.2	2.8	.3	− .3	.8	−1.2	− .7	− .4	8.0
30	.6	.....	2.2	1.0	1.9	.3	− .5	.1	−1.2	− .7	− .4	7.0
31	.7	.....	1.9	.....	1.7	.....	− .5	− .3	.....	− .7	.....	7.2

Station rating table for Oconee River at Dublin, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−1.30	690	0.80	2,280	2.90	4,060	6.00	7,090
−1.20	750	.90	2,360	3.00	4,150	6.20	7,310
−1.10	810	1.00	2,440	3.10	4,240	6.40	7,530
−1.00	875	1.10	2,520	3.20	4,330	6.60	7,750
− .90	945	1.20	2,605	3.30	4,420	6.80	7,970
− .80	1,015	1.30	2,690	3.40	4,510	7.00	8,190
− .70	1,090	1.40	2,775	3.50	4,600	7.50	8,790
− .60	1,165	1.50	2,860	3.60	4,695	8.00	9,390
− .50	1,240	1.60	2,945	3.70	4,790	8.50	9,990
− .40	1,320	1.70	3,030	3.80	4,885	9.00	10,640
− .30	1,400	1.80	3,115	3.90	4,980	9.50	11,290
− .20	1,480	1.90	3,200	4.00	5,075	10.00	11,990
− .10	1,560	2.00	3,285	4.20	5,265	10.50	12,690
0.00	1,640	2.10	3,370	4.40	5,455	11.00	13,430
.10	1,720	2.20	3,455	4.60	5,650	11.50	14,180
.20	1,800	2.30	3,540	4.80	5,850	12.00	14,930
.30	1,880	2.40	3,625	5.00	6,050	12.50	15,700
.40	1,960	2.50	3,710	5.20	6,250	13.00	16,500
.50	2,040	2.60	3,795	5.40	6,450	13.50	17,300
.60	2,120	2.70	3,880	5.60	6,650	14.00	18,100
.70	2,200	2.80	3,970	5.80	6,870		

The above table is based on discharge measurements made during 1903-1905. It is well defined between gage heights −1 foot and + 7 feet. The table has been extended beyond these limits. Above gage height 14 feet the rating curve is a tangent, the difference being 170 per tenth.

Estimated monthly discharge of Oconee River at Dublin, Ga., for 1905.

[Drainage area, 4,182 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	6,050	1,960	3,021	.722	.832
February	27,450	2,120	11,260	2.69	2.80
March	8,550	3,200	5,082	1.22	1.41
April	6,350	2,440	3,506	.838	.935
May	6,870	1,800	3,538	.846	.975
June	3,455	1,240	1,947	.466	.520
July	6,550	1,240	2,839	.679	.783
August	6,055	810	2,685	.642	.740
September	3,970	750	1,346	.322	.359
October	1,960	690	1,019	.244	.281
November	2,775	945	1,346	.322	.359
December	19,120	1,320	8,121	1.94	2.24
The year	27,450	690	3,810	.911	12.23

OHOOPEE RIVER NEAR REIDSVILLE, GA.

This station was established June 13, 1903, by F. A. Murray. It is located at the wooden highway bridge known as Sheppards Bridge, 4½ miles west of Reidsville, Ga.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the outer edge of the first cross beam at the left end of the bridge, downstream side.

The original gage consisted of two 5-foot sections spiked to the bridge and a third section fastened to a cypress tree on the left bank above the bridge. June 10, 1905, the gage was changed to the right side of the second bent from the left bank. It is fastened to the bent in four 5-foot sections. The gage is read by J. D. Swain, who is paid by the Georgia Geological Survey. Bench marks were established as follows: (1) The top of the cap of the fifth bent from the left end of the bridge on the upstream side, opposite a point 106 feet from the initial point for soundings; elevation, 20.00 feet. (2) Two nails driven horizontally into the downstream side of a cypress tree on the left bank, about 120 feet above the bridge; elevation, 8.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 81-82; 127, pp 85-86.
Discharge: 98, p 82; 127, p 86.
Discharge, monthly: 98, p 84; 127, p 88.
Gage heights: 98, pp 82-83; 127, p 87.
Rating table: 98, p 83; 127, p 87.

Discharge measurements of Ohoopee River near Reidsville, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 16	W. E. Hall	141	1,755	2.39	11.90	4,204
March 17	do	141	1,755	2.37	11.90	4,163
April 27	F. A. Murray	114	1,137	1.44	6.38	1,635
June 10	A. T. Mitchelson	118	533	.21	1.01	114
July 28	F. A. Murray	110	638	.57	2.31	363
November 8[a]	do	69	96	.59	.36	57
November 8[a]	do	70	93	.60	.34	56

[a] Made at different section.

Daily gage height, in feet, of Ohoopee River near Reidsville, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	3.6	9.7	6.2	5.3	1.9	1.0	2.5	1.7	0.7	0.7	0.6
2	2.9	3.7	9.1	5.9	5.3	1.7	1.2	2.4	1.5	.8	.6	.6
3	2.7	3.5	8.7	5.4	5.2	1.5	1.3	2.1	1.3	1.0	.6	.9
4	2.5	3.4	8.2	5.2	5.1	1.4	1.3	2.0	1.4	.9	.5	1.0
5	2.4	3.5	7.9	5.1	5.3	1.4	1.2	1.7	1.7	.8	.4	1.9
6	2.3	3.7	7.5	5.3	5.2	1.4	3.4	1.0	2.0	.7	.4	2.6
7	2.4	4.2	7.2	5.6	4.8	1.3	5.1	1.1	1.7	.6	.4	2.6
8	2.7	4.5	7.0	5.4	4.0	1.1	5.8	1.0	1.4	.6	.4	2.2
9	3.0	5.0	6.8	5.0	3.7	1.0	6.0	1.0	1.1	.5	.4	1.8
10	3.3	5.7	7.1	4.9	3.5	1.0	6.3	1.0	.9	.5	.4	1.9
11	3.3	5.9	7.4	5.2	3.2	.9	5.9	1.4	.8	.5	.4	2.0
12	3.5	6.8	8.9	5.5	2.9	.9	5.8	1.8	.8	.5	.4	2.1
13	3.9	8.6	10.5	6.1	2.7	.8	5.2	2.0	.7	.4	1.5	2.1
14	4.8	10.2	11.3	6.7	2.4	1.8	4.5	2.8	.7	.4	1.8	1.8
15	5.0	12.7	11.7	7.6	2.1	1.4	3.7	3.7	.9	.4	1.6	1.9
16	5.2	15.9	11.9	7.9	1.9	1.8	4.8	3.7	1.4	.4	1.2	2.3
17	5.5	19.0	11.9	8.2	1.9	1.3	5.0	3.5	1.3	.4	1.1	2.3
18	5.5	15.0	11.6	7.3	2.3	1.4	4.7	3.3	1.5	.4	.9	3.2
19	5.1	14.6	11.3	7.2	2.7	1.4	5.0	3.3	1.3	.4	.9	3.3
20	4.9	13.7	11.1	7.2	2.8	1.5	5.7	3.1	1.0	.4	.8	3.0
21	4.7	11.8	10.4	6.5	2.7	1.3	4.7	3.0	.9	.4	.8	3.3
22	4.6	11.6	9.6	6.1	2.6	1.3	3.8	2.7	.8	.4	.7	4.1
23	4.5	12.0	9.0	6.8	2.4	1.3	3.0	2.5	.8	.4	.6	5.6
24	4.3	12.5	8.5	7.0	2.6	1.3	2.6	2.5	.6	.3	.6	6.8
25	4.2	12.2	8.3	7.2	3.0	1.2	2.1	2.1	.5	.3	.6	8.0
26	4.2	11.7	8.0	6.9	3.2	1.0	1.8	2.1	.5	.3	.6	7.9
27	4.1	11.1	7.9	6.2	3.2	1.2	1.7	2.8	.5	.4	.6	7.9
28	4.0	10.5	7.8	5.9	2.8	1.2	2.3	3.1	.5	.4	.6	7.6
29	3.8	.....	7.4	5.6	2.2	1.0	2.9	2.9	.5	.7	.6	7.5
30	3.6	.....	7.1	5.4	2.0	1.0	2.7	2.5	.6	.9	.6	7.8
31	3.6	.....	6.7	.....	2.0	.....	2.6	2.1	.....	.8	.....	8.2

Station rating table for Ohoopee River near Reidsville, Ga., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.30	50	2.30	321	4.40	895	8.20	2,531
.40	57	2.40	341	4.60	968	8.40	2,633
.50	65	2.50	361	4.80	1,043	8.60	2,737
.60	74	2.60	382	5.00	1,120	8.80	2,843
.70	83	2.70	403	5.20	1,198	9.00	2,950
.80	93	2.80	425	5.40	1,277	9.20	3,058
.90	104	2.90	447	5.60	1,357	9.40	3,167
1.00	115	3.00	470	5.80	1,438	9.60	3,277
1.10	127	3.10	494	6.00	1,520	9.80	3,388
1.20	140	3.20	519	6.20	1,602	10.00	3,500
1.30	153	3.30	545	6.40	1,685	10.20	3,617
1.40	167	3.40	572	6.60	1,771	10.40	3,738
1.50	182	3.50	600	6.80	1,860	10.60	3,862
1.60	197	3.60	629	7.00	1,950	10.80	3,989
1.70	213	3.70	659	7.20	2,042	11.00	4,120
1.80	230	3.80	690	7.40	2,136	11.50	4,460
1.90	247	3.90	722	7.60	2,232	12.00	4,820
2.00	265	4.00	755	7.80	2,330	12.50	5,198
2.10	283	4.20	824	8.00	2,430	13.00	5,590
2.20	302						

The above table is based on 26 discharge measurements made during 1903-1905. It is well defined between gage heights 0.0 and 11 feet. Above gage height 11 feet the table is determined by one measurement at 14 feet. The discharge is only approximate above 13 feet.

Estimated monthly discharge of Ohoopee River near Reidsville, Ga., for 1905.

[Drainage area, 1,280 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,317	321	744	0.581	0.670
February	10,390	572	3,512	2.74	2.85
March	4,746	1,815	2,989	2.34	2.70
April	2,531	1,081	1,625	1.27	1.42
May	1,237	247	588	.459	.529
June	247	93	154	.120	.134
July	1,643	115	750	.586	.676
August	659	115	349	.273	.315
September	265	65	126	.098	.109
October	115	50	69.4	.054	.062
November	230	57	89.9	.070	.078
December	2,531	74	860	.672	.775
The year	10,390	50	988	.772	10.32

MISCELLANEOUS MEASUREMENTS IN ALTAMAHA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Altamaha River drainage basin during 1905:

Brazzell Creek near Reidsville, Ga.—A measurement was made by wading at a narrow channel one-fourth mile above the mouth and one-half mile from the regular gaging station on Ohoopee River at Reidsville, Ga. The gage height by the gage at the Ohoopee River station at the same time was 2.35 feet.

Width, 12 feet; area, 6.6 square feet; mean velocity, 0.85 foot per second; discharge, 5.6 second-feet.

Jacks Creek at Anniestown, Ga.—A measurement was made from a foot log on the river road about one-fourth mile above Hayden's Bridge, about one-half mile from Anniestown, Ga. The bench mark is the head of a large wire nail driven into the downstream face of a double-trunk birch tree on the right bank, 20 feet below the road; elevation, 5.00 feet above the datum of the assumed gage.

Width, 8.5 feet; area, 3.7 square feet; mean velocity, 1.32 feet per second; gage height, 1.88 feet; discharge, 4.9 second-feet.

Little River near Milledgeville, Ga.—This stream enters Oconee River from the right. It was measured from the downstream side of a wooden highway bridge 9 miles north of Milledgeville, Ga., 1 mile above the mouth. The initial point for soundings is the end of the hand rail at the left bank. The bench mark is a copper brand in the top of the downstream end of the cross beam at the first pier from the left bank; elevation, 15.00 feet above the datum of the assumed gage.

September 15: Width, 99 feet; area, 92 square feet; mean velocity, 1.23 feet per second; gage height, 3.51 feet; discharge, 113 second-feet.

November 24: Width, 119 feet; area, 132 square feet; mean velocity, 1.55 feet per second; gage height, 3.86 feet; discharge, 205 second-feet.

Little Ocmulgee River at Lumber City, Ga.—A measurement was made July 26, 1905, by wading about 90 feet upstream from the wagon bridge on which a bench mark was established in September, 1904, three-fourths mile northeast of Lumber City, Ga. The bench mark is the top of the downstream end of the cap of the second bent from the right bank; elevation, 23.00 feet above the datum of the assumed gage.

Width, 48 feet; area, 25 square feet; mean velocity, 1.64 feet per second; gage height, 1.46 feet; discharge, 41 second-feet.

Little Ocmulgee River at Wilcox, Ga.—A measurement was made July 25, 1905, at a wooden wagon bridge 2½ miles from Lumber City and one-eighth mile from Wilcox Station, Ga. The bench mark is the center of a lag screw driven into the end of the second floor beam from the right bank on the downstream side; elevation, 18.00 feet above the datum of the assumed gage.

Width, 52.5 feet; area, 61.5 square feet; mean velocity, 0.58 foot per second; gage height, 1.25 feet; discharge, 35.5 second-feet.

Ohoopee River near Ohoopee, Ga.—A measurement was made July 29, 1905, from the downstream side of a wooden highway bridge about 2 miles southeast of Ohoopee, Ga., above the mouth of Pendletons Creek. The initial point for soundings is the end of the hand rail at the left bank, downstream side. The bench mark is the top of the upstream end of the cap of the bent, 64 feet from the left end of the hand rail; elevation, 19.00 feet above the datum of the assumed gage.

Width, 84 feet; area, 314 square feet; mean velocity, 0.57 foot per second; gage height, 4.22 feet; discharge, 180 second-feet.

Pendletons Creek near Lyons, Ga.—A measurement was made July 29, 1905, from a new wooden highway bridge 3½ miles east of Lyons, Ga., about one-half mile above the crossing of the Seaboard Air Line. Bench marks established for former measurements at this point were carried away by a flood. A new bench mark was established, the top of the down-

stream end of the cap of the third bent from the right-bank end of the bridge; elevation, 17.00 feet above the datum of the assumed gage.

Width, 74 feet; area, 341 square feet; mean velocity, 1.23 feet per second; gage height, 7.58 feet; discharge, 438 second-feet.

Snapping Shoals Creek at Snapping Shoals, Ga.—A measurement was made October 24, 1905, at a bridge about 80 feet above the mouth of Snapping Shoals Creek, 400 feet below the gage on South River at Snapping Shoals, Ga. The bench mark is the top of the wooden stringer 13½ feet from the left-bank end; elevation, 12.00 feet above the datum of the assumed gage.

Width, 21 feet; area, 12 square feet; mean velocity, 1.17 feet per second; gage height, 0.54 foot; discharge, 14 second-feet.

South River at Snapping Shoals, Ga.—A measurement was made on South River October 24, 1905, from a boat, just below the mouth of Snapping Shoals Creek, and about 500 feet below the wagon bridge at Snapping Shoals, Ga. The bench mark is the top of the downstream end of the first floor beam of the bridge to the left of the center pier; elevation, 26.00 feet above the datum of the assumed gage.

Width, 78 feet; area, 122 square feet; mean velocity, 1.18 feet per second; gage height, 3.00 feet; discharge, 144 second-feet.

Sugar Creek at Wilcox, Ga.—A measurement was made July 25, 1905, at a new wagon bridge 75 feet upstream from the Southern Railway bridge at Wilcox, Ga. The bench mark is the top of the downstream wooden stringer 126 feet from the right end of the downstream hand rail of the bridge; elevation, 22.06 feet above the datum of the assumed gage.

Width, 15 feet; area, 18 square feet; mean velocity, 0.30 foot per second; gage height, 3.88 feet; discharge, 5.5 second-feet.

Yellow River near Lithonia, Ga.—Measurements were made from a wagon bridge about 4 miles north of Lithonia, Ga. The bench mark is the top of the downstream corner of the right-bank stone abutment; elevation, 16.55 feet above the datum of the assumed gage.

September 15: Width, 28 feet; area, 40 square feet; mean velocity, 1.70 feet per second; gage height, 1.96 feet; discharge, 68 second-feet.

APALACHICOLA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Apalachicola River is formed by the union of Flint and Chattahoochee rivers at the Georgia-Florida line. It flows in a southerly direction through Florida to the Gulf of Mexico. It is navigable, and boats run up Flint River to Albany, Ga., and up Chattahoochee River to Columbus, Ga.

Flint River rises in Fulton County, Ga., a few miles south of Atlanta. It flows in a southerly direction to Talbot County, southeastward to Macon County, southward to Worth County, and southwestward to Apalachicola River. It drains the south-central portion of Georgia, extending from Atlanta south to the Florida line. The tributaries of Flint River are mainly large creeks with much fall. The principal ones among these are Whitewater, Whitecoak, Redoak, Elkins, Big Potato, Muckalee, Kinchafoonee, Ichawaynochaway, and Spring creeks.

Flint River has many good water powers on its course. Between a point opposite Woodbury, Ga., and a point opposite Knoxville, Ga., in Crawford County, a distance of about 45 miles, the river falls 334 feet. Very little of its power is yet developed.

Chattahoochee River rises in the Blue Ridge, in White County, and flows in a southwesterly direction until it reaches the Alabama line at the southeast corner of Troup County, Ga. Thence it flows in a southerly direction, forming the western boundary of Georgia, until it flows into Apalachicola River at the southern boundary of the State. It drains almost all the north-central, middle-western, and southwestern portions of Georgia, and has a drainage area of 4,900 square miles at Columbus, Ga., which is at the fall line.

Soque River joins the Chattahoochee on the western edge of Habersham County. This river rises in Habersham County and flows in a southwesterly direction. It has considerable fall, dropping as much as 40 feet within a few hundred feet.

Farther down the Chattahoochee, at the west boundary of Hall County, Chestatee River enters. It rises in Lumpkin County and flows in a southerly direction through a very hilly and steep country and has much fall all along its course.

From its source down to Columbus, Ga., Chattahoochee River is an excellent water-power stream. From the lower edge of Lumpkin County down to Columbus, Ga., there is a fall of over 850 feet, 366 feet of this fall being between West Point and Columbus. All along its course there are many small tributaries flowing from a high, hilly country. These have much fall, and many water powers are available.

The following pages give the results of data collected in this drainage during 1905:

CHATTAHOOCHEE RIVER NEAR NORCROSS, GA.

This station was established June 10, 1902, by M. R. Hall. It is located at Medlock's toll bridge, about 4½ miles north of Norcross, Ga. This point is above the mouth of Johns Creek and below the mouth of Sewannee Creek.

The channel is slightly curved for 600 feet above and 700 feet below the station. The current is sluggish at low stages, but not excessively so, and the discharge measurements are considered good at the lowest stage. The right bank is high and will overflow only for 50 feet from the water's edge; the left bank will overflow for about 800 feet at a gage height of from 16 to 18 feet. The bed of the stream is sandy and probably changes.

Discharge measurements are made from the downstream side of the single-span bridge and its approaches. The initial point for soundings is 50 feet to the right of the center of the downstream tubular pier on the right bank.

The original gage was a vertical staff attached to an oak tree on the right bank 100 feet above the bridge. A chain gage, established March 14, 1903, was read in connection with the vertical gage until June 28, 1905, when a standard chain gage was attached to the downstream lower chord of the first panel from the right bank; length of chain, 30.36 feet. The gage is read twice each day by W. O. Medlock, who is paid by the Georgia Geological Survey. Bench marks were established as follows: (1) The top of the iron pier on the right bank, downstream side; elevation, 27.00 feet. (2) A copper plug set in a stone post set flush with the surface of the ground at the side of the road just outside of the toll bridge, on the right bank, in line with the downstream side of the bridge and 145 feet from the center of the pier at the right-bank end of the bridge; elevation, 26.92 feet. (3) The bottom of the gage box at the pulley; elevation, 28.36 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 121-122; 127, pp 92-93.
Discharge: 83, p 127; 98, p 122; 127, p 93.
Discharge, monthly: 98, p 124; 127, p 95.
Gage heights: 98, p 123; 127, p 94.
Rating table: 98, p 123; 127, p 94.

Discharge measurements of Chattahoochee River near Norcross, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 13	B. S. Drane	224	3,221	5.00	12.26	16,120
January 13	do	224	3,179	4.96	12.10	15,780
January 13	do	224	3,129	4.73	11.82	14,790
January 14	do	184	1,811	2.57	5.29	4,653
January 14	do	184	1,770	2.54	5.05	4,501
March 2	M. R. Hall	163	1,342	1.45	2.94	1,949
May 27	A. T. Mitchelson	166	1,403	1.65	3.19	2,320
May 27	M. R. Hall	165	1,339	1.65	3.16	2,209
June 28	F. A. Murray	160	1,135	1.00	2.01	1,139
September 22	M. R. Hall	159	938	.76	1.51	713
September 22	do	159	1,040	.70	1.52	733
October 28	do	163	1,018	1.02	1.90	1,035
October 28	F. A. Murray	163	1,025	1.03	1.92	1,054
October 28	do	163	1,018	1.02	1.90	1,042
December 9	do	197	2,375	4.01	8.56	9,521

Daily gage height, in feet, of Chattahoochee River near Norcross, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.15	3.0	2.4	2.65	2.5	10.5	2.0	1.8	1.72	1.72	1.48
2	1.98	2.1	2.95	2.35	2.4	2.4	6.1	1.95	2.15	1.82	1.7	1.6
3	2.0	2.05	2.85	2.3	2.6	2.35	3.3	1.9	2.25	1.68	1.68	8.4
4	1.93	2.05	2.8	2.35	3.3	2.3	2.7	1.85	1.95	1.72	1.68	7.6
5	1.83	2.0	2.7	2.45	3.0	2.25	3.2	1.9	1.85	1.95	1.65	3.6
6	2.02	2.2	2.65	2.6	3.1	2.2	3.8	1.85	1.8	1.72	1.68	2.9
7	3.15	2.95	2.65	2.6	5.3	2.2	4.2	1.9	1.75	1.6	1.82	2.65
8	2.9	3.3	2.7	2.45	4.5	2.1	3.2	2.3	1.72	1.55	2.2	2.85
9	2.35	5.1	2.7	2.5	4.6	2.1	2.85	2.6	1.73	1.5	1.92	7.2
10	2.2	6.7	2.9	2.5	3.5	2.05	3.7	2.7	1.7	1.58	2.1	8.1
11	2.2	5.1	3.3	2.4	3.0	2.0	5.2	3.6	1.68	2.7	1.88	4.4
12	6.5	4.3	3.1	2.4	2.8	2.0	7.4	3.8	1.9	3.5	1.25	3.4
13	11.9	7.7	2.9	2.6	2.7	2.3	6.0	4.2	1.75	2.2	1.2	3.0
14	5.3	6.7	2.8	2.5	2.6	2.1	4.0	3.6	1.72	1.9	1.25	2.85
15	3.7	4.3	2.8	2.4	2.5	2.1	4.2	3.8	1.63	1.82	2.15	2.95
16	3.1	3.6	2.7	2.6	3.9	2.35	3.6	2.9	1.6	1.82	1.92	3.1
17	2.8	3.3	2.6	2.45	4.0	2.45	2.9	2.65	1.6	1.88	1.98	2.9
18	2.65	3.1	2.55	2.35	3.1	2.3	2.8	2.4	1.6	1.78	1.82	2.75
19	2.55	2.95	2.55	2.3	2.8	2.15	2.6	2.3	1.6	1.75	1.75	2.6
20	2.55	4.1	2.55	2.3	2.7	2.1	2.5	2.25	1.6	1.75	1.75	3.2
21	2.5	11.5	2.65	2.3	2.6	2.6	2.7	2.2	1.55	1.7	1.95	5.8
22	2.35	6.9	3.2	2.3	2.8	2.6	2.7	2.1	1.52	1.68	1.88	5.2
23	2.2	5.1	2.85	2.3	4.0	2.7	2.4	2.25	1.53	1.62	1.78	3.8
24	2.2	4.2	2.7	2.2	6.0	2.3	2.2	2.5	1.5	1.62	1.57	3.8
25	2.1	3.8	2.6	2.2	4.0	2.15	2.25	2.4	1.47	1.68	1.52	3.4
26	2.1	3.6	2.6	2.2	3.4	2.0	2.2	2.2	1.48	1.82	1.8	3.2
27	2.25	3.3	2.5	2.3	3.2	2.1	2.15	2.3	1.6	2.2	1.8	2.95
28	2.35	3.2	2.5	2.4	3.0	2.05	2.1	2.0	1.25	1.95	1.75	2.9
29	2.1	.....	2.4	2.4	2.9	2.4	2.1	1.9	1.42	1.8	1.75	3.0
30	2.1	.....	2.5	2.6	2.8	2.25	2.2	1.85	1.47	1.75	1.52	3.1
31	2.1	.....	2.5	.....	2.6	.....	2.2	1.85	.....	1.75	.....	2.85

NOTE.—Low gage heights can be accounted for as resulting from storage at the Gainesville water-power plant.

Station rating table for Chattahoochee River near Norcross, Ga., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	480	2.50	1,645	3.90	3,205	5.60	5,345
1.20	515	2.60	1,750	4.00	3,320	5.80	5,615
1.30	560	2.70	1,860	4.10	3,440	6.00	5,885
1.40	615	2.80	1,970	4.20	3,560	6.20	6,160
1.50	680	2.90	2,080	4.30	3,680	6.40	6,440
1.60	750	3.00	2,190	4.40	3,800	6.60	6,720
1.70	830	3.10	2,300	4.50	3,920	6.80	7,005
1.80	920	3.20	2,410	4.60	4,045	7.00	7,295
1.90	1,015	3.30	2,520	4.70	4,170	7.20	7,585
2.00	1,120	3.40	2,630	4.80	4,295	7.40	7,885
2.10	1,225	3.50	2,745	4.90	4,425	7.60	8,185
2.20	1,330	3.60	2,860	5.00	4,555	7.80	8,495
2.30	1,435	3.70	2,975	5.20	4,815	8.00	8,805
2.40	1,540	3.80	3,090	5.40	5,075	8.20	9,125

The above table is based on discharge measurements made during 1902-1905 and is well defined.

Estimated monthly discharge of Chattahoochee River near Norcross, Ga., for 1905.

[Drainage area, 1,170 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	15,570	948	2,238	1.91	2.20
February	14,820	1,120	3,753	3.21	3.34
March	2,520	1,540	1,899	1.62	1.87
April	1,750	1,330	1,540	1.32	1.47
May	5,885	1,540	2,552	2.18	2.51
June	1,860	1,120	1,381	1.18	1.32
July	13,030	1,225	2,786	2.38	2.74
August	3,560	968	1,609	1.38	1.59
September	1,382	538	824	.704	.786
October	2,745	680	991	.847	.976
November	1,330	515	893	.763	.851
December	9,445	667	3,225	2.76	3.18
The year	15,570	515	1,974	1.69	22.85

CHATTAHOOCHEE RIVER NEAR VININGS, GA.

This station was established in 1905, for the purpose of making a series of miscellaneous measurements, at a new iron highway bridge 1 mile east of Vinings, Ga., and about 10 miles northwest of Atlanta, Ga. It is about 10 miles below the developed power at Bull Sluice.

The current of the section is fairly good, and regular, and while the bed is probably somewhat shifting there is a stretch of swift water immediately below, running among permanent rocks which will probably control the water level at the station. The left bank is high and will not overflow; the right bank is only about 20 feet above low water for a width of 900 feet and will overflow during very high floods.

Discharge measurements are made from the bridge of two 140-foot spans, with 50 feet of wooden approach at the left bank and 100 feet at the right bank.

No gage has been established. The effect of the water power above being to cause a great amount of fluctuation in the flow, the mean daily gage height can be obtained only by the use of an automatic recording gage, and until this is accomplished the measurements are made mainly as investigations relative to the accuracy of the rating in case the original Chattahoochee River station which was located at Oakdale, 4 miles below, should be continued at this place. Gage heights are determined directly from the bench mark, which is the top of the upstream end of the second floor beam from the left bank; elevation, 31.00 feet above the datum of the assumed gage.

Discharge measurements of Chattahoochee River near Vinings, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 4	W. E. Hall	249	1,130	1.74	4.51	1,966
August 18	do	256	1,081	1.85	4.68	2,003
August 18	do	256	1,057	1.76	4.57	1,861
October 17	M. R. Hall	238	761	1.12	3.43	856
November 27	do	242	820	1.22	3.74	1,002

CHATTAHOOCHEE RIVER (LOWER GAGE) NEAR OAKDALE, GA.

This station was established in 1905, for the purpose of making a series of miscellaneous measurements, at a new iron highway bridge just below the old Mason and Turners Ferry, where the Oakdale "lower gage" was maintained as a regular station during parts of the years 1898 and 1899. It is 1½ miles below the Southern Railway bridge where the Oakdale station was located.

Discharge measurements are made from the bridge of two 130-foot spans, with 300 feet of wooden approach at the right bank and 730 feet at the left. At high floods both banks will overflow to the extent of the bridge approaches, but can not get beyond at either end. The current is mostly swift and is irregular at places.

Gage heights are determined directly from the bench mark, which is the top of the downstream end of the second-floor beam from the right bank; elevation, 35.00 feet above the datum of the assumed gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 85-87; Bull 140, pp 75-76; WS 15, p 46; 27, p 47; 36, pp 139-140; 48, p 158; 65, p 269; 83, p 122; 98, pp 119-120; 127, pp 95-96.

Discharge: Ann 18, iv, p 87; Bull 140, p 76; WS 15, p 46; 27, p 57; 36, p 140; 48, p 158; 65, p 269; 83, p 122; 98, p 120; 127, p 96.

Discharge, monthly: Ann 18, iv, p 89; 19, iv, p 236; 20, iv, pp 180, 182; 21, iv, p 140; 22, iv, p 191; WS 75, p 79; 83, p 124; 98, p 121; 127, p 98.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: Bull 140, p 77; WS 11, pp 23-24; 15, p 46; 27, p 50; 36, pp 141-142; 48, p 159; 65, p 270; 83, p 123; 98, p 120; 127, p 97.

Hydrographs: Ann 18, iv, p 89; 19, iv, p 236; 20, iv, p 182; 21, iv, p 141; 22, iv, p 191.

Rainfall and run-off relation: Ann 20, iv, p 181.

Rating tables: Ann 18, iv, p 88; 19, iv, p 235; WS 27, p 58; 39, pp 444, 445; 52, p 513; 65, p 322; 83, p 124; 98, p 121; 127, p 97.

Discharge measurements of Chattahoochee River (lower gage) near Oakdale, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 28	M. R. Hall	236	553	2.32	4.11	1,284
May 25	W. E. Hall	254	1,572	2.98	8.16	4,687
May 25	A. T. Mitchelson	254	1,625	2.98	8.30	4,845

CHATTAHOOCHEE RIVER AT WEST POINT, GA.

This station was established July 30, 1896, by M. R. Hall, and the gage is now maintained by the United States Weather Bureau. It is located at the Montgomery street wagon bridge.

The channel is straight for about 2,000 feet above and 3,000 feet below the station. The current has a fair velocity, except at low stages. The right bank is high and overflows only at high water, when most of the town is covered. The left bank is somewhat lower and overflows for about 800 feet at a gage height of 20 feet. The bed of the stream is of sand and gravel and is unstable.

The bridge from which discharge measurements are made is in three spans, with short approaches from each end. The floor of the bridge is about 24 feet above low water. The initial point for soundings is the end of the hand rail on the right bank, downstream side of the bridge.

A standard chain gage is fastened to the outside of the iron railing of the downstream footway at a point 122 feet from the initial point for soundings; length of chain, 29.26 feet. Bench marks were established as follows: (1) The top of the downstream end of the second iron floor beam under the bridge floor from the right-bank end of the bridge; elevation, 24.19 feet. (2) The top of the thirty-eighth milepost on the Franklin and West Point survey of the United States Engineers. This post is a cast-iron cap 6 inches square, set in concrete, and approximately on a level with the ground, It is marked "U. S. 38." A raised point in the center of the cap is the bench mark; elevation, 15.68 feet. The location of this post is on the right bank of the river, 340 feet upstream from the wagon bridge and 50 feet from the edge of the river. It is 60 feet south of the Episcopal Church. (3) The top of the first marble block and bottom of the second marble block of the Confederate monument in the center of the street, 1,300 feet from the initial point for soundings and 860 feet from the east end of the bridge; elevation, 25.56 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 90-91; WS 15, p 47; 27, p 47; 36, p 142; 48, p 159; 65, p 270; 83, pp 119-120; 98, pp 116-117; 127, pp 98-99.

Discharge: Ann 18, iv, p 91; 19, iv, p 237; WS 15, p 47; 27, p 57; 36, p 142; 48, p 159; 65, p 270; 83, p 120; 98, p 117; 127, p 99.

Discharge, monthly: Ann 18, iv, p 92; 19, iv, p 239; 20, iv, pp 180, 183; 21, iv, p 141; 22, iv, p 192; WS 75, p 80; 83, p 121; 98, p 119; 127, p 101.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: WS 11, p 24; 15, p 47; 27, p 51; 36, p 143; 48, p 160; 65, p 271; 83, p 120; 98, pp 117-118 127, p 100.

Hydrographs: Ann 19, iv, p 239; 20, iv, p 183; 21, iv, p 142; 22, iv, p 192; WS 75, p 80.

Rainfall and run-off relation: Ann 20, iv, p 181.

Rating tables: Ann 18, iv, p 91; 19, iv, p 238; WS 27, p 58; 39, p 445; 52, p 514; 65, p 322; 83, p 121; 98 p 118; 127, p 100.

Discharge measurements of Chattahoochee River at West Point, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage. height.	Dis-charge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 24	J. M. Giles	389	3,151	1.28	3.28	4,026
June 6	W. E. Hall	377	2,662	.77	2.30	2,048
October 28	do	377	2,655	.85	2.30	2,252

Daily gage height, in feet, of Chattahoochee River at West Point, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	2.6	3.6	2.7	3.3	2.8	2.8	2.2	1.9	1.9	1.88	2.15
2	2.6	2.5	3.5	2.7	2.5	2.5	4.4	2.0	1.8	3.6	1.85	1.98
3	2.3	2.4	3.4	2.7	2.7	2.4	7.8	1.3	2.2	2.7	1.85	10.6
4	2.3	2.4	3.3	2.5	3.0	2.3	4.9	2.0	2.5	2.1	1.85	13.6
5	2.3	2.7	3.2	2.8	2.9	2.3	3.2	1.9	2.9	1.8	1.9	10.2
6	2.2	3.0	3.2	2.9	2.9	2.1	2.9	1.6	2.2	1.7	1.85	6.2
7	2.6	3.2	3.1	2.9	3.1	2.1	3.9	1.5	2.0	1.6	1.76	4.2
8	2.8	4.0	3.1	2.9	2.9	2.1	4.9	1.5	1.8	1.7	1.95	5.3
9	2.6	8.5	3.1	2.9	4.3	2.1	7.8	2.6	1.7	1.5	1.88	9.8
10	3.0	8.3	3.6	3.3	4.0	2.0	4.8	2.7	1.7	1.8	2.0	8.8
11	2.7	7.3	3.3	3.2	3.9	1.9	4.2	3.0	1.6	2.35	2.8	8.9
12	3.4	7.0	3.1	3.2	3.3	1.7	5.8	4.1	1.6	2.7	3.0	6.4
13	12.6	9.2	3.6	3.1	3.0	1.6	8.7	5.2	1.8	2.35	2.5	4.6
14	10.6	8.9	3.6	2.9	2.7	1.6	8.2	5.5	1.7	2.9	2.1	4.0
15	10.2	8.5	3.3	2.8	2.5	1.9	5.4	4.6	1.7	2.5	2.1	3.9
16	5.5	6.1	3.2	3.0	2.4	2.2	3.9	6.2	1.6	2.1	2.1	3.9
17	4.0	4.8	3.1	3.0	2.8	2.5	3.7	4.7	1.5	2.0	2.0	3.8
18	3.6	4.3	3.1	2.5	3.0	2.2	3.2	4.4	1.6	1.8	2.0	3.7
19	3.4	3.9	3.0	2.6	3.7	2.9	2.8	3.5	1.5	1.8	2.0	3.5
20	3.3	3.8	3.0	2.6	3.0	2.4	2.5	2.8	1.6	1.9	2.05	5.4
21	3.2	4.5	3.5	2.6	2.9	2.4	2.7	2.6	1.4	1.7	1.98	9.4
22	3.1	6.9	3.6	2.7	2.8	2.3	2.0	2.2	1.3	1.7	2.0	8.7
23	3.0	9.3	3.3	2.8	2.9	2.5	2.5	2.8	1.3	1.65	1.95	7.1
24	2.7	6.0	3.4	2.8	4.1	2.5	2.3	3.4	1.3	1.72	1.95	6.0
25	2.7	4.9	3.1	2.4	4.0	2.6	2.3	4.0	1.5	1.85	1.95	4.9
26	2.6	4.4	3.0	2.6	5.0	2.9	2.7	3.7	1.4	2.8	1.98	4.4
27	2.3	4.0	3.0	2.6	4.1	2.2	2.5	3.0	1.3	2.7	2.0	4.0
28	2.3	3.8	2.8	2.0	3.5	2.2	2.0	2.6	1.3	2.25	2.1	3.8
29	2.4	.....	2.8	2.0	3.2	2.4	1.4	2.0	1.3	2.1	2.1	3.8
30	2.5	.....	2.8	2.6	3.1	3.1	2.6	2.1	1.5	2.0	2.1	3.6
31	2.5	.....	2.7	.....	2.9	.....	2.3	2.0	.....	1.98	.....	3.6

NOTE.—From October 1 to December 31 two readings a day were made, before that, only one reading

Station rating table for Chattahoochee River at West Point, Ga., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	800	2.10	1,970	3.20	3,700	4.60	6,760
1.00	850	2.20	2,100	3.30	3,890	4.80	7,240
1.10	920	2.30	2,240	3.40	4,080	5.00	7,740
1.20	1,000	2.40	2,380	3.50	4,280	5.20	8,240
1.30	1,090	2.50	2,530	3.60	4,500	5.40	8,740
1.40	1,180	2.60	2,680	3.70	4,720	5.60	9,260
1.50	1,280	2.70	2,840	3.80	4,940	5.80	9,780
1.60	1,380	2.80	3,000	3.90	5,160	6.00	10,300
1.70	1,490	2.90	3,170	4.00	5,380	6.20	10,840
1.80	1,600	3.00	3,340	4.20	5,830	6.40	11,380
1.90	1,720	3.10	3,520	4.40	6,290	6.60	11,940
2.00	1,840						

The above table is based on discharge measurements made during 1903-1905. It is well defined between gage heights 1.2 feet and 11.4 feet. Above gage height 6.5 feet the rating curve is a tangent, the difference being 290 per tenth.

Estimated monthly discharge of Chattahoochee River at West Point, Ga., for 1905.

[Drainage area, 3,300 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	29,340	2,100	5,363	1.63	1.88
February	19,770	2,380	8,915	2.70	2.81
March	4,500	2,840	3,733	1.13	1.30
April	3,890	1,840	2,930	.888	.991
May	7,740	2,380	3,869	1.17	1.35
June	3,520	1,380	2,257	.684	.763
July	18,030	1,180	5,724	1.73	1.99
August	10,840	1,090	3,743	1.13	1.30
September	3,170	1,090	1,505	.456	.509
October	4,500	1,280	2,032	.616	.710
November	3,340	1,556	1,923	.583	.650
December	32,240	1,816	10,380	3.15	3.63
The year	32,240	1,090	4,365	1.32	17.88

SOQUE RIVER NEAR DEMOREST, GA.

This station was established July 16, 1904, by M. R. Hall. It is located at Cannon Bridge, on the road from Cornelia to Acorn, 2½ miles from Demorest and about 4 miles above the mouth of the river.

The channel is curved for 500 feet above and slightly curved for 500 feet below the station. The current is swift. Both banks are high and wooded. The right bank overflows during extreme high water. The bed of the stream is composed largely of rock and is permanent. There is but one channel at all stages.

Discharge measurements are made from the single-span wooden wagon bridge. The bridge has a 28-foot approach on the left bank and a 90-foot approach on the right bank. The initial point for soundings is the end of the bridge on the upstream side at the left bank.

The gage is in two sections; the first is a vertical staff, reading from 0 to 10 feet, fastened to the sill and upstream post of the trestle bent at the left bank. An additional section,

established September 12, 1905, is a vertical staff, reading from 0.7 foot to 6 feet, fastened to the stump of an ironwood tree on the right bank about 20 feet above the bridge. The gage is read once each day by Charles Cannon. Bench marks were established as follows: (1) The top of the upstream end of the right-bank wooden pier, marked with white paint; elevation, 21.20 feet. (2) A nail in the stump of the ironwood tree, to which the second section of the gage is attached; elevation, 6.00 feet. Elevations refer to the datum of the gage.

A description of this station, gage-height and discharge data, and rating table, are contained in Water-Supply Paper of the United States Geological Survey No. 127, pages 102–103.

Discharge measurements of Soque River near Demorest, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 2	W. E. Hall	81	235	1.22	2.12	287
May 27	do	81	241	1.38	2.41	334
July 19	Hoyt and Hall	81	237	1.38	2.26	327
September 6	F. A. Murray	81	152	1.29	1.81	196
September 12	M. R. Hall	81	143	1.37	1.81	196
October 23	F. A. Murray	81	156	1.08	1.71	168

Daily gage height, in feet, of Soque River near Demorest, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.75	2.25	1.9	1.9	2.0	8.6	2.0	1.6	1.8	1.75	1.7
2	1.65	1.75	2.2	1.85	1.95	2.0	3.1	1.9	1.9	1.8	1.75	1.7
3	1.65	1.8	2.1	1.85	2.1	2.1	2.3	2.0	1.9	1.85	1.7	6.8
4	1.6	1.8	2.1	1.8	2.0	2.1	2.0	2.0	1.85	1.75	1.7	3.2
5	1.6	1.85	2.05	2.0	1.95	2.1	1.9	1.9	1.85	1.7	1.7	2.2
6	2.25	1.9	2.0	2.0	3.5	2.0	3.9	1.9	1.8	1.7	1.75	2.1
7	2.7	2.0	2.0	1.9	3.35	2.0	3.1	2.7	1.8	1.7	1.7	2.0
8	1.9	2.0	2.0	1.9	2.4	2.0	2.1	2.7	1.8	1.75	1.7	1.95
9	1.85	3.5	2.1	1.85	2.2	2.9	2.1	2.3	1.8	3.5	1.7	6.6
10	1.85	3.4	2.4	1.8	2.1	3.0	3.1	2.8	1.8	2.4	1.75	3.0
11	1.8	3.1	2.15	1.8	2.05	2.6	3.0	4.2	1.8	2.2	1.75	2.5
12	7.4	3.3	2.2	1.85	2.05	2.4	3.5	3.5	1.75	2.0	1.7	2.3
13	3.8	3.4	2.15	1.85	2.0	2.2	2.7	2.6	1.8	1.9	1.7	2.2
14	2.15	3.1	2.1	1.8	1.9	1.95	6.9	2.5	1.8	1.85	1.7	2.1
15	2.1	2.8	2.1	1.8	3.7	1.8	4.3	3.4	1.8	1.8	1.7	2.1
16	2.0	2.6	2.05	1.8	3.4	1.95	4.3	2.1	1.8	1.8	1.7	2.2
17	1.9	2.2	2.05	1.8	2.9	2.1	2.7	2.1	1.75	1.8	1.65	2.1
18	1.9	2.2	2.0	1.8	2.1	2.0	2.3	2.1	1.75	1.8	1.65	2.1
19	1.85	2.1	2.0	1.8	2.05	2.8	2.2	2.1	1.75	1.8	1.7	2.0
20	1.85	7.1	2.0	1.85	2.0	2.6	4.1	2.1	1.8	1.85	1.7	3.1
21	1.8	5.4	2.0	1.8	2.0	2.6	2.7	2.0	1.8	1.8	1.7	3.6
22	1.8	3.1	2.0	1.85	2.1	2.4	2.6	2.0	1.75	1.75	1.7	2.4
23	1.8	2.8	2.0	1.85	4.0	2.2	2.4	2.2	1.75	1.7	1.7	2.4
24	1.75	2.6	1.95	1.8	2.8	2.1	2.1	2.1	1.75	1.7	1.7	2.4
25	1.75	2.5	1.95	1.8	2.4	1.95	2.1	2.1	1.75	1.75	1.75	2.4
26	1.7	2.4	1.95	2.2	2.4	1.85	2.0	2.3	1.8	2.1	1.9	2.4
27	2.0	2.35	1.95	2.0	2.4	1.8	1.95	2.1	1.8	2.0	1.8	2.2
28	1.9	2.25	1.95	1.9	2.2	1.8	2.0	1.95	1.75	1.8	1.75	2.4
29	1.8	.....	1.95	1.95	2.8	1.85	2.1	2.0	1.7	1.8	1.7	2.2
30	1.7	.....	1.9	1.9	2.7	11.9	2.1	1.75	1.8	1.75	1.7	2.2
31	1.7	.....	1.9	.....	2.1	.....	2.1	1.65	.....	1.75	.....	2.1

Station rating table for Soque River near Demorest, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	151	2.30	330	2.90	531	3.50	770
1.70	171	2.40	361	3.00	568	3.60	815
1.80	193	2.50	393	3.10	606	3.70	860
1.90	217	2.60	426	3.20	645	3.80	905
2.00	243	2.70	460	3.30	685	3.90	950
2.10	271	2.80	495	3.40	725	4.00	1,000
2.20	300						

The above table is based upon discharge measurements made during 1904-1905. It is well defined between gage heights, 1.6 feet and 4.2 feet. The table has been extended beyond these limits. Above gage height 4 feet the rating curve is a tangent, the difference being 50 per tenth.

Estimated monthly discharge of Soque River near Demorest, Ga., for 1905.

[Drainage area, 112 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,700	151	314	2.80	3.23
February	2,550	182	527	4.71	4.90
March	361	217	257	2.29	2.64
April	300	193	210	1.88	2.10
May	1,000	217	390	3.48	4.01
June	4,950	193	455	4.06	4.53
July	3,300	217	626	5.59	6.44
August	1,100	161	343	3.06	3.53
September	217	151	190	1.70	1.90
October	770	171	222	1.98	2.28
November	217	161	175	1.56	1.74
December	2,400	171	474	4.23	4.88
The year	4,950	151	349	3.12	42.18

SWEETWATER CREEK NEAR AUSTELL, GA.

This station was established May 6, 1904, by M. R. Hall. It is located at the south side of Lithia Springs Park, near Austell, Ga. The station is maintained in cooperation with the Georgia Geological Survey, by which the gage reader is paid.

The channel is straight for about 300 feet above and 200 feet below the gage. The current is sluggish above the gage; below it is swift for about 50 feet at several places, with sluggish water between. Both banks are high and wooded, the right being composed of rock, and are not liable to overflow. There is but one channel at all stages.

Discharge measurements are made from a boat at low and ordinary stages about 400 yards below the gage. High-water measurements are made from Strickland's wagon bridge, 1½ miles down stream.

The gage is in two sections. The first section is an inclined staff, reading to 8 feet, fastened to solid rock on the right bank. The second section is a vertical staff, reading from 8 to 16 feet, fastened to a maple tree on the right bank about 100 feet upstream. The gage is read twice each day by J. L. Causey. Bench marks were established as follows: (1) A nail in a small maple on the right bank about 200 feet below the gage; elevation, 5.00 feet. (2) A cross cut on a large rock about 10 feet south of the sloping section of the gage; elevation, 10.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 93; 127, pp 103, 119.
Discharge: Ann 19, iv, p 240; WS 36, p 141; 83, pp 127, 128; 127, pp 104, 119.
Gage heights: WS 127, p 104.

Discharge measurements of Sweetwater Creek near Austell, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage. height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 18	W. E. Hall	67	283	0.80	3.02	227
January 18	do	67	280	.78	3.01	220
March 7 [b]	do	65	263	.76	2.80	200
May 10 [a]	M. R. Hall	45	146	1.01	2.13	147
May 10 [a]	do	45	142	.96	2.10	136
August 16 [c]	W. E. Hall	35	126	3.56	4.44	448
August 16 [c]	do	35	126	3.48	4.44	438
October 7 [a]	M. R. Hall	42	119	1.03	1.91	123
October 7 [a]	do	42	118	1.01	1.89	119

[a] At boat landing below gage.
[b] 1,000 feet below gage.
[c] Measurement made one-third mile east of Austell, Ga.

Daily gage height, in feet, of Sweetwater Creek near Austell, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	3.0	3.1	2.35	2.75	1.75	4.0	1.8	1.85	7.2	1.85	2.05
2	2.05	2.6	3.0	2.35	2.35	1.7	3.6	1.65	1.95	5.4	1.7	2.45
3	2.1	2.45	3.0	2.35	2.45	1.6	2.55	1.65	2.1	2.8	1.55	9.6
4	2.05	2.55	2.8	2.3	2.55	1.6	2.2	1.65	3.3	2.45	1.75	12.9
5	2.0	2.45	2.8	2.55	2.35	1.65	5.6	1.5	2.7	2.35	1.75	6.7
6	3.3	2.5	2.8	2.9	2.45	1.55	4.6	1.4	2.55	2.05	1.75	4.0
7	2.8	2.55	2.8	2.8	2.1	1.35	7.0	1.7	1.65	1.85	1.75	3.6
8	2.75	4.4	2.8	2.75	2.15	1.45	11.6	1.45	1.55	1.7	1.8	5.8
9	2.55	7.2	2.85	2.8	2.4	1.25	8.6	1.8	1.55	1.6	1.8	10.2
10	2.3	10.2	3.4	2.65	2.1	1.25	8.8	3.1	1.6	1.65	2.6	11.6
11	2.8	8.6	4.0	2.6	1.95	1.05	9.2	3.4	1.1	2.4	3.4	10.4
12	11.2	6.0	4.1	2.6	1.75	1.0	16.7	4.7	1.65	2.35	3.0	6.4
13	14.4	6.5	3.6	2.5	1.65	1.15	10.7	8.2	1.65	2.2	2.5	4.0
14	11.4	6.8	3.2	2.4	1.65	1.45	5.1	4.4	1.7	2.0	2.2	3.4
15	4.7	6.4	3.0	2.55	1.7	1.55	3.4	3.9	1.35	1.95	2.1	3.5
16	3.4	6.0	2.9	2.8	2.85	1.55	2.9	4.4	1.35	2.0	2.0	3.5
17	3.5	5.6	2.8	2.55	4.0	1.45	2.65	3.9	1.45	2.1	1.95	3.6
18	3.0	5.3	2.75	2.5	2.7	1.35	2.3	3.8	1.6	1.4	1.95	3.5
19	3.0	5.2	2.7	2.4	2.05	1.5	2.25	3.6	1.5	1.8	1.95	3.6
20	3.2	6.6	2.85	2.4	1.9	1.95	2.3	2.8	1.4	1.7	2.0	5.2
21	3.0	7.1	3.7	2.3	1.85	1.4	2.1	2.65	1.35	1.75	1.95	6.4
22	2.8	6.9	3.7	2.2	2.45	1.7	2.1	2.85	1.25	1.65	2.05	6.1
23	2.45	5.5	3.1	2.2	2.9	2.3	1.85	3.9	1.25	1.65	1.9	5.7
24	2.4	4.4	2.85	2.2	5.1	2.7	1.75	5.8	1.4	1.65	1.95	5.2
25	2.2	3.7	2.55	2.15	4.5	2.5	2.35	6.5	1.4	1.85	2.1	4.9
26	2.1	3.4	2.5	2.2	3.3	2.1	2.4	4.1	1.35	2.4	2.5	4.4
27	2.25	3.2	2.5	2.2	2.7	2.85	1.9	2.8	1.3	2.4	2.65	4.0
28	2.2	3.2	2.45	2.1	2.4	3.0	1.75	2.05	1.15	2.2	2.6	3.6
29	2.25	.....	2.4	2.5	2.3	3.6	1.9	1.9	1.15	2.0	2.25	3.6
30	2.4	.....	2.5	2.6	2.3	2.7	2.15	1.7	1.65	1.8	2.02	3.4
31	3.2	.....	2.4	.....	2.0	.....	1.8	1.7	.....	1.75	.....	3.4

MULBERRY CREEK NEAR COLUMBUS, GA.

This station was established June 23, 1904, by W. E. Hall, for the purpose of making a series of miscellaneous measurements. It is located at Mitchells Bridge, about 16 miles north of Columbus, Ga., and 12 miles south of Hamilton, Ga. Mulberry Creek is a tributary of Chattahoochee River, which it enters about 6 miles west of the station.

The channel is straight for about 50 feet above and 200 feet below the bridge. The current is rather sluggish above and swift below the station. Both banks are high and not liable to overflow. The right bank is clean; the left bank is wooded and covered with brush. The bed of the stream is composed of rock and sand. There is but one channel at all stages, broken by one wooden pier. The bottom is very uneven, causing the current to change directions during low water.

Discharge measurements are made from the downstream side of the two-span highway bridge, resting upon stone abutments and center wooden pile bent. The initial point for soundings is the left end of the bridge on the downstream side.

Gage heights are determined directly from the bench mark, which is the top of the downstream end of the wooden cap of center pile bent; elevation, 32.00 feet above the datum of the assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, page 105.

Discharge measurements of Mulberry Creek near Columbus, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 17	W. E. Hall	41	68	1.13	1.63	77
June 17	do	41	68	1.21	1.63	82
September 26	do	34	38	.44	1.00	16.6
September 26	do	34	38	.46	1.01	17.7

FLINT RIVER NEAR WOODBURY, GA.

Measurements of the flow of Flint River were made during 1897 and 1898 at Molina, Ga., but the river bed was so shifting that the station was discontinued June 2, 1898. Two measurements were made in 1899 at the Macon and Birmingham Railroad bridge, near Woodbury, Ga., 5 miles below the Molina station. March 29, 1900, a gage was put in near this bridge and the station was reestablished.

The channel above and below the station is slightly curved for 800 feet. Above gage height 10 feet the banks are subject to overflow for a width of 300 or 400 feet, but all water passes beneath the bridge and its approaches. The bridge and its piers are oblique to the direction of the current, and the bed is rough and irregular and mostly permanent.

Discharge measurements are made from the Macon and Birmingham Railroad bridge. This is a two-span iron bridge, each span being 150 feet long and supported by brick piers. There are wooden trestle approaches, about 150 feet long on the right bank and 225 feet long on the left. The initial point for soundings is the end of the iron bridge, on the right bank, downstream side.

The gage is in 5-foot sections; the part reading from zero to 10 feet is attached to a willow tree on the left bank about 300 feet above the bridge and 50 feet below Riggins's old ferry; the section reading from 10 to 15 feet is fastened to a sweet-gum tree 50 feet from the left bank and 150 feet upstream from the bridge. This gage was maintained by the Georgia geological survey until November 1, 1900, when it was adopted by the United States Weather Bureau. The observer is G. A. Wright, who is paid by the Weather Bureau. Bench marks were established as follows: (1) The top of the downstream end of the second and third crossbeams from the left-bank end of the bridge; elevation, 27.00 feet. (2) A cut in the hickory tree on the upstream side of the old ferry landing, 50 feet from

the left bank of the river and about 75 feet upstream from the gage; elevation, 7.00 feet. (3) A copper plug set in solid rock on the west side of the river about 100 feet from the water and 100 feet upstream from a point opposite the gage; elevation, 16.29 feet. Elevations refer to the datum of the gage, which is 660 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 48, pp 157-158; 65, pp 265-266; 83, p 117; 98, pp 113-114; 127, pp 105-106, 119.
Discharge: Ann 19, iv, p 240; WS 48, p. 158; 65, p 266; 83, p 118; 98, p 114; 127, pp 106, 119.
Discharge, monthly: Ann 22, iv, p 190; WS 75, p 78; 83, p 119; 98, p 116; 127, p 109.
Gage heights: WS 48, p 158; 65, p 266; 83, p 118; 98, p 115; 127, p 107.
Hydrograph: Ann 22, iv, p 190.
Rating tables: WS 52, p 513; 65, p 321; 83, p 119; 98, p 115; 127, p 108.

Discharge measurements of Flint River near Woodbury, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 10	W. E. Hall	253	885	0.95	0.91	844
April 21	M. R. Hall	246	644	.84	.52	544
June 3	Hall and Mitchelson	235	620	.49	.03	307
September 19	W. E. Hall	238	622	.28	−.28	173

Daily gage height, in feet, of Flint River near Woodbury, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	0.5	1.0	0.6	0.7	0.1	1.7	0.1	0.0	0.3	0.2	0.4
2	.6	.5	.9	.5	.6	.1	2.6	.0	.0	.6	.1	.3
3	.7	.4	.8	.5	.7	.2	2.6	−.1	.2	.4	.1	2.9
4	.6	.4	.7	.5	1.2	.1	1.5	−.1	.6	.6	.1	4.0
5	.5	.5	.6	1.0	1.4	.2	1.3	−.2	.6	.7	.1	5.0
6	.5	.6	.8	1.2	1.3	.1	1.0	−.2	.3	.4	.0	4.4
7	.6	1.0	.8	1.1	.9	.0	.6	−.3	.3	.2	.1	3.4
8	.7	1.9	.8	1.0	.6	.0	.7	.2	.1	.0	.1	2.1
9	.6	3.0	.8	.9	.8	−.1	.6	.5	.0	−.1	.1	2.7
10	.5	3.2	.9	1.1	.8	−.1	.5	2.2	−.1	.0	.2	2.9
11	.4	2.7	1.0	1.1	.7	−.2	.9	2.3	−.2	.1	.9	3.0
12	.9	3.5	1.1	1.0	.5	−.2	1.2	2.3	−.2	.3	1.1	2.7
13	2.1	5.4	1.3	1.1	.4	−.1	1.2	2.1	.0	.4	1.0	2.1
14	2.0	6.3	1.2	1.0	.3	.1	.7	2.0	.0	.4	.8	1.7
15	1.9	4.9	1.0	.8	.3	.3	.6	1.8	−.1	.3	.6	1.5
16	1.6	3.5	.9	.8	.4	.5	.5	2.6	−.2	.3	.5	1.5
17	1.3	2.5	.9	.8	.5	.2	.4	3.9	−.2	.2	.4	1.4
18	1.0	2.1	.8	.7	.5	.1	.2	2.6	−.3	.1	.3	1.3
19	.8	1.7	.7	.6	.3	.1	.1	1.5	−.3	.1	.2	1.2
20	.8	1.5	.6	.6	.2	.0	.4	.8	−.3	.1	.2	2.5
21	.8	2.0	1.0	.6	.3	.0	.1	.6	−.3	.0	.2	5.3
22	.7	2.0	1.1	.5	.4	.1	.3	.4	−.4	.0	.1	5.4
23	.6	1.8	1.3	.5	.4	.3	.0	.3	−.4	.0	.1	4.8
24	.6	1.7	1.2	.5	.8	.4	−.1	.4	−.4	.0	.2	4.5
25	.5	1.5	1.0	.5	.7	.4	.3	1.2	−.5	−.1	.2	2.8
26	.4	1.3	.8	.4	.5	.2	.1	1.0	−.5	.8	.2	2.2
27	.4	1.1	.7	.4	.4	.2	.0	.9	−.4	.6	.2	1.7
28	.3	1.0	.7	.4	.3	.1	.1	.7	−.4	.5	.2	1.6
29	.3	.....	.6	.5	.3	.2	.3	.3	−.4	.3	.2	1.5
30	.4	.....	.6	.6	.2	.3	.1	.1	−.2	.3	.3	1.4
31	.5	.....	.5	.....	.2	.....	.1	.1	.....	.2	.....	1.3

Station rating table for Flint River near Woodbury, Ga., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
− 0.50	120	1.00	1,005	2.50	2,760	3.90	4,690
−.40	150	1.10	1,115	2.60	2,890	4.00	4,840
−.30	180	1.20	1,225	2.70	3,020	4.20	5,160
−.20	210	1.30	1,340	2.80	3,150	4.40	5,480
−.10	240	1.40	1,455	2.90	3,280	4.60	5,820
.00	280	1.50	1,570	3.00	3,410	4.80	6,160
.10	320	1.60	1,685	3.10	3,545	5.00	6,520
.20	360	1.70	1,800	3.20	3,680	5.20	6,880
.30	410	1.80	1,920	3.30	3,820	5.40	7,260
.40	470	1.90	2,040	3.40	3,960	5.60	7,640
.50	540	2.00	2,160	3.50	4,100	5.80	8,040
.60	620	2.10	2,280	3.60	4,240	6.00	8,450
.70	705	2.20	2,400	3.70	4,390	6.50	9,550
.80	800	2.30	2,520	3.80	4,540	7.00	10,750
.90	900	2.40	2,640				

The above table is based on 21 discharge measurements made during 1901–1905. It is well defined between gage heights −0.3 foot and 4.5 feet. The table has been extended beyond these limits, being based on one measurement at 9.2 feet.

Estimated monthly discharge of Flint River near Woodbury, Ga., for 1905.

[Drainage area, 988 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,280	410	837	.847	.976
February	9,100	470	2,454	2.48	2.58
March	1,340	540	885	.896	1.03
April	1,225	470	751	.760	.848
May	1,455	360	627	.635	.732
June	540	210	334	.338	.377
July	2,890	240	789	.799	.921
August	4,690	180	1,164	1.18	1.36
September	620	120	251	.254	.283
October	800	240	412	.417	.481
November	1,115	280	446	.451	.503
December	7,260	410	3,016	3.05	3.52
The year	9,100	120	997	1.01	13.61

FLINT RIVER NEAR MONTEZUMA, GA.

This station is located at the iron highway bridge about 1 mile west of Montezuma, Ga. Some discharge measurements had already been made at this point when the United States Weather Bureau established a standard chain gage on the bridge, late in 1904. During 1905 the daily gage heights have been furnished by the Weather Bureau.

The channel is slightly curved above and below the station, which is near the point of reverse between the curves. The current is moderate. The right bank will overflow for a great distance at about 12 feet above low water. It is mostly covered with a dense growth of brush. The left bank is not apt to overflow. The bed is sandy and probably shifting and the current is slow at low stage, especially near the left bank.

Discharge measurements are made from the bridge of two 100-foot spans, with a short trestle approach on the left bank and a very long one across the marshy ground on the right bank. The initial point for soundings is the end of the left-bank approach, downstream side.

The gage is located on the upstream side of the right span of the bridge near the middle pier. The bench mark is the top of the upstream tubular pier at the middle of the bridge; elevation, 28.00 feet above the datum of the gage.

Discharge measurements of Flint River near Montezuma, Ga.

Date.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage. height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
1901.						
July 18	F. A. Murray	173	1,976	1.21	4.38	2,398
1904.						
September 21	J. M. Giles	188	1,300	.75	1.85	971
1905.						
August 23	F. A. Murray	198	1,553	1.03	3.15	1,608
August 31	do	198	1,393	.90	2.41	1,249
October 12	W. E. Hall	195	1,326	.86	2.25	1,148

Daily gage height, in feet, of Flint River near Montezuma, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.1	3.2	6.0	4.3	3.6	4.0	3.3	1.8	2.3	1.8	2.1	2.4
2	4.4	3.2	5.8	4.0	3.6	3.5	5.1	1.9	3.3	4.1	2.1	2.3
3	4.1	3.2	5.6	4.0	4.5	3.0	6.5	1.9	4.6	4.0	2.0	2.6
4	4.7	3.2	5.5	4.0	5.3	3.0	7.5	1.8	4.2	3.2	2.0	3.9
5	3.4	3.2	5.1	4.0	6.0	3.0	7.5	1.7	4.0	3.3	2.0	7.0
6	3.4	3.5	5.0	4.3	5.7	3.2	5.8	1.6	3.8	3.0	2.0	8.2
7	3.5	3.7	5.0	4.8	5.6	2.9	5.0	1.5	3.4	3.4	2.0	9.0
8	3.6	5.4	4.8	5.2	6.3	2.7	3.9	1.4	3.2	2.9	2.0	9.7
9	3.6	7.4	4.7	5.0	6.2	2.4	3.2	1.3	2.5	2.4	1.9	9.9
10	3.6	9.2	4.7	4.9	5.7	2.2	2.5	2.3	2.0	2.2	2.0	8.8
11	3.5	10.5	6.0	4.7	4.8	2.2	2.5	5.2	1.8	2.0	2.6	8.7
12	3.4	12.0	6.4	4.5	4.3	2.0	3.0	6.6	1.7	2.2	4.1	8.5
13	4.0	14.0	6.7	5.6	3.9	2.0	4.0	7.0	1.6	2.4	4.7	8.6
14	4.6	15.0	8.2	7.6	3.5	2.1	4.4	7.6	2.7	2.4	4.6	8.2
15	7.6	17.3	8.6	8.5	3.2	2.3	4.0	8.2	2.9	2.2	4.6	7.0
16	7.2	17.1	6.7	7.1	3.2	2.4	3.7	7.7	2.3	2.1	4.0	6.2
17	6.4	15.5	6.0	5.7	5.1	2.5	3.0	7.4	1.9	2.1	3.2	5.6
18	5.7	13.9	5.5	5.0	6.6	3.1	2.8	7.1	1.6	2.2	2.9	5.5
19	5.0	12.5	5.2	4.7	5.6	3.2	2.5	7.7	1.5	2.1	2.5	5.4
20	5.0	10.0	5.0	4.3	4.8	2.5	2.3	7.4	1.5	2.0	2.5	5.6
21	5.0	9.0	5.8	4.2	3.6	2.3	2.1	5.0	1.4	2.0	2.5	8.0
22	4.3	8.5	6.4	4.1	3.5	2.2	2.0	3.7	1.4	1.9	3.6	10.0
23	4.0	9.0	8.0	4.1	3.3	2.3	2.0	3.1	1.3	1.9	3.7	11.7
24	4.0	9.3	7.2	4.3	4.6	2.5	2.0	3.0	1.3	1.8	3.8	13.7
25	3.9	9.5	6.6	4.0	6.0	3.4	2.0	3.0	1.2	1.8	3.0	13.9
26	3.7	8.0	6.0	3.7	6.2	2.9	2.1	3.7	1.1	1.8	2.4	13.0
27	3.6	7.2	5.7	3.8	5.2	2.4	2.3	4.3	1.0	2.4	2.5	11.8
28	3.3	6.5	5.2	3.9	5.0	2.4	2.2	3.5	1.2	3.7	2.4	9.4
29	3.2	.....	4.9	3.8	4.2	2.5	2.0	3.2	1.2	3.4	2.4	7.9
30	3.2	.....	4.7	3.7	3.6	2.9	1.9	2.8	1.4	3.0	2.4	6.8
31	3.2	.....	4.5	.....	3.7	.....	1.8	2.5	.....	2.2	.....	6.6

FLINT RIVER AT ALBANY, GA.

This station was originally established by the United States Weather Bureau April 10, 1893, and has been maintained from that date to the present. Discharge measurements by the Geological Survey were begun at this station in 1901, and the gage-height records furnished by the Weather Bureau have been used, except for a portion of the year 1903. The present observer, D. W. Brosnan, is paid by the United States Weather Bureau.

The channel above the station is straight for about 1,000 feet and is rough. Below the station the channel is straight for 700 feet. The river overflows both banks, but only under the approaches to the bridge. The bed is constant, but is rough, and the current is irregular.

Discharge measurements are made from the two-span railroad bridge of the Atlantic Coast Line, which is 325 feet long, with 475 feet of trestle approach on the right bank and 240 feet on the left bank. The initial point for soundings is the center of the tubular iron pier on the upstream side of the bridge on the left bank.

The gage was washed out and replaced in 1898. It was again injured in 1902, and was replaced by a new gage June 17, 1902. The new gage was set 0.75 foot lower than the old gage as it existed prior to June 17, 1902. The gage heights were corrected from January 1 to June 17, 1902, inclusive, to correspond with the new gage. The Weather Bureau gage is attached to the Dougherty County Bridge, located about 700 feet below the Atlantic Coast Line bridge. It is in three sections. Section No. 1 is attached to the crib around the middle piers and extends to 4 feet above zero. Section No. 2 is spiked to a green cypress tree just above the bridge on the west bank of the river, and reads from 2 to 17 feet. Section No. 3 is spiked to a cedar post 16 feet high. This section begins at 17 feet and reads to 32 feet.

A standard chain gage belonging to the United States Geological Survey was installed April 20, 1904. It is fastened to the hand railing of the downstream footway of the Dougherty County Bridge near the middle of the west span. The gage was accurately set to correspond with the bench marks previously established, and its readings agree with the standard portion of the Weather Bureau gage. The bottom of the box is 45.34 feet above the zero of the gage, and the length of the chain is 47.34 feet.

Bench marks were established as follows: (1) A copper plug set in the downstream corner of the brick abutment on the right bank under the Dougherty County Bridge; elevation, 33.81 feet. (2) The top of the first crossbeam from the right bank, upstream end of the railroad bridge; elevation, 43.20 feet. (3) A chisel mark on the tubular pier of the wagon bridge on the right bank, downstream side; elevation, 10.00 feet. (4) The top of the third granite block of the Confederate monument at the center of Jackson and Pine streets. This is at the bottom of the polished block which bears the inscription; elevation, 61.09 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 27, p 47; 36, p 138; 48, pp 156-157; 65, p 266; 83, pp 114-115; 98, pp 105-107; 127, pp 109-111.
Discharge: 65, p 266; 83, p 115; 98, p 107; 127, p 111.
Discharge, monthly: 83, p 117; 98, p 108; 127, p 113.
Gage heights: 27, pp 49-50; 36, p 139; 48, p 157; 65, p 267; 83, pp 115-116; 98, p 107; 127, p 112.
Rating tables: 83, p 116; 98, p 108; 127, p 113.

Discharge measurements of Flint River at Albany, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	W. E. Hall	242	2,212	2.89	4.38	6,398
August 25	F. A. Murray	226	1,470	2.09	1.42	3,073
August 28	do	226	1,551	2.34	1.82	3,634
October 14	W. E. Hall	222	1,436	1.84	.79	2,640

Daily gage height, in feet, of Flint River at Albany, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	2.2	8.0	5.0	4.6	2.8	1.9	0.5	0.8	0.0	1.2	0.8
2	3.8	2.4	7.2	4.7	4.2	3.1	2.4	.4	.8	1.0	.8	.7
3	3.1	2.3	6.7	4.5	4.9	3.2	3.0	.4	1.1	1.8	.7	1.1
4	2.6	2.3	6.3	4.2	5.9	2.7	4.0	.4	1.6	2.5	.6	1.3
5	2.2	2.2	5.9	4.1	6.4	2.2	4.4	.5	2.5	2.2	.6	2.2
6	2.0	2.2	5.7	4.1	6.7	2.0	4.4	.4	2.0	2.0	.4	3.6
7	2.3	2.6	5.5	4.0	6.6	2.0	4.0	.2	1.6	1.8	.6	4.5
8	2.7	3.2	5.2	4.2	6.1	2.0	2.9	.1	1.5	1.6	.5	5.1
9	2.7	5.2	5.1	5.0	5.5	1.7	2.2	.2	1.1	1.6	.3	6.0
10	2.5	6.7	5.8	5.4	5.4	1.4	1.6	.5	.7	1.3	.4	6.6
11	2.3	8.3	6.0	5.6	4.8	1.2	1.5	1.2	.5	1.7	.8	7.0
12	2.1	10.9	7.8	6.0	4.0	1.1	1.6	3.1	.3	.9	1.2	6.0
13	2.6	15.5	9.6	7.9	3.6	1.0	1.7	4.2	.5	.8	1.9	6.5
14	3.4	18.4	10.7	9.4	3.1	1.0	1.5	5.9	.3	.8	3.1	6.0
15	4.6	21.4	10.3	10.6	2.7	1.4	1.3	5.6	.2	.3	2.4	6.4
16	6.0	25.2	10.1	9.8	2.5	1.6	1.8	5.8	.1	.8	2.7	6.3
17	6.4	25.3	9.3	9.1	2.7	1.6	2.0	5.8	.4	.9	1.7	5.7
18	6.1	24.5	8.1	7.6	3.7	1.9	1.8	5.2	.4	.9	1.6	5.55
19	5.6	23.8	7.0	6.3	4.8	2.0	1.4	4.6	.2	.5	1.2	5.3
20	4.8	22.7	6.3	5.4	5.0	2.4	1.2	4.5	.1	.7	1.2	6.3
21	4.0	21.2	8.0	4.8	4.3	1.8	1.0	4.6	.0	.5	1.0	6.0
22	3.6	19.1	9.3	4.7	3.5	2.0	.9	3.8	.0	.4	.8	6.8
23	3.4	17.0	10.1	4.9	2.8	1.6	.7	2.4	−.1	.4	.6	9.2
24	3.3	14.0	9.7	4.9	4.3	1.9	.7	1.7	−.1	.3	.6	10.9
25	3.3	12.0	9.5	4.7	4.5	2.4	.8	1.4	−.2	.0	.8	11.8
26	3.1	11.1	9.1	4.4	5.1	2.5	.8	1.3	−.2	.5	.7	12.6
27	2.9	10.1	8.2	4.4	5.8	2.2	.7	1.6	−.3	.4	.8	13.4
28	2.8	9.0	7.2	4.4	5.4	1.5	.5	1.7	−.4	.6	1.0	13.6
29	2.5	.....	6.4	4.6	4.4	1.4	.8	1.7	−.2	1.3	1.0	13.3
30	2.3	.....	5.8	4.7	3.7	1.8	.8	1.3	−.3	1.3	.9	11.9
31	2.2	.....	5.4	.....	3.0	.....	.7	1.1	.....	1.4	.....	9.8

Station rating table for Flint River at Albany, Ga., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−.50	1,480	1.70	3,425	3.90	5,645	8.00	10,300
−.40	1,560	1.80	3,520	4.00	5,750	8.50	10,900
−.30	1,645	1.90	3,615	4.20	5,970	9.00	11,500
−.20	1,730	2.00	3,710	4.40	6,190	9.50	12,100
−.10	1,815	2.10	3,805	4.60	6,410	10.00	12,700
0.00	1,900	2.20	3,900	4.80	6,630	10.50	13,350
.10	1,985	2.30	4,000	5.00	6,850	11.00	14,000
.20	2,070	2.40	4,100	5.20	7,080	11.50	14,675
.30	2,155	2.50	4,200	5.40	7,310	12.00	15,350
.40	2,240	2.60	4,300	5.60	7,540	12.50	16,050
.50	2,330	2.70	4,400	5.80	7,770	13.00	16,750
.60	2,420	2.80	4,500	6.00	8,000	13.50	17,525
.70	2,510	2.90	4,600	6.20	8,230	14.00	18,300
.80	2,600	3.00	4,700	6.40	8,460	14.50	19,150
.90	2,690	3.10	4,805	6.60	8,690	15.00	20,000
1.00	2,780	3.20	4,910	6.80	8,920	15.50	20,850
1.10	2,870	3.30	5,015	7.00	9,150	16.00	21,700
1.20	2,960	3.40	5,120	7.20	9,380	17.00	23,400
1.30	3,050	3.50	5,225	7.40	9,610	18.00	25,200
1.40	3,140	3.60	5,330	7.60	9,840	19.00	27,000
1.50	3,235	3.70	5,435	7.80	10,070	20.00	28,900
1.60	3,330	3.80	5,540				

The above table is based on 22 discharge measurements made during 1902-1905. It is well defined between gage heights 0 and 6 feet. Above gage height 6 feet the table is approximate.

Estimated monthly discharge of Flint River at Albany, Ga., for 1905.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	8,460	3,710	5,156	1.03	1.19
February	38,970	3,900	17,540	3.51	3.66
March	13,610	6,965	9,862	1.97	2.27
April	13,480	5,750	7,622	1.52	1.70
May	8,805	4,200	6,348	1.27	1.46
June	4,910	2,780	3,636	.727	.811
July	6,190	2,330	3,532	.706	.814
August	7,885	1,985	4,140	.828	.955
September	4,200	1,560	2,343	.469	.523
October	4,200	1,900	2,794	.559	.644
November	4,805	2,155	2,854	.571	.637
December	17,680	2,510	9,232	1.85	2.13
The year	38,970	1,560	6,255	1.25	16.79

BIG POTATO CREEK NEAR THOMASTON, GA.

This station was established in 1904 for the purpose of making a series of miscellaneous measurements. It is located at the highway bridge about 5 miles southwest of Thomaston Ga., 200 yards above Daniel's old gristmill.

The channel is curved for about 200 feet above and straight for 300 feet below the station. The current is fairly swift except at very low stages. Both banks are subject to occasional overflow. The bed of the stream is composed of rock and gravel, free from vegetation, and probably constant. There is but one channel at all stages, broken during the higher water by the piers of the bridge.

Discharge measurements are made from the downstream side of the single-span iron bridge, which has trestle approaches of about 100 feet at each end. The initial point for soundings is the left end of the bridge on the downstream side.

Gage heights are determined directly from the bench marks, which are as follows: (1) The top of the downstream end of the first floor beam from the left bank; elevation, 23.00 feet. (2) A chisel mark on the intermediate post at the downstream end of the second floor beam; elevation, 28.00 feet. Elevations refer to the datum of the assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 114, 120.

Discharge measurements of Big Potato Creek near Thomaston, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
September 21 [a]	W. E. Hall	30	21	1.48	1.60	31
September 21 [b]	do	69	96	.21	1.53	20

[a] 700 feet below bridge.
[b] Measured at Daniel's mill bridge.

NOTE.—There is a mill some distance above this point, which affects the flow more than was at first thought, making the discharge measurement of little or no value.

MUCKALEE CREEK NEAR LEESBURG, GA.

This station was established in 1905 for the purpose of making a series of miscellaneous low-water measurements in connection with the regular station on Kinchafoonee Creek. It is located about 3 miles east of Leesburg, Ga., at a wooden highway bridge consisting of two truss spans, with trestle approaches about 50 feet each.

The current is slow at low water. The right bank will overflow at moderately high water for a long distance.

Gage heights are determined directly from the bench mark, which is the top of the upstream end of the wooden cap of the middle bent of the bridge; elevation, 17.00 feet above the datum of the assumed gage.

Discharge measurements at this station are contained in Water-Supply Paper of the United States Geological Survey No. 98, p. 128.

Discharge measurements of Muckalee Creek near Leesburg, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage. height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 30	F. A. Murray	73	244	0.79	2.02	192
October 13	W. E. Hall	68	300	.96	2.75	288

KINCHAFOONEE CREEK NEAR LEESBURG, GA.

This station was established August 30, 1905, by F. A. Murray. It is located at the iron highway bridge 1 mile east of Leesburg, Ga.

The channel is nearly straight for about 400 feet above and below the station, and the current is mostly swift. The right bank is lower than the bridge and will probably overflow at times around the end of the bridge approach. The left bank will not overflow. The bed of the stream is sandy, and the current is good, except for a small amount of sluggish water at the left bank.

Discharge measurements are made from the downstream side of the single-span bridge. The initial point for soundings is the left end of the bridge.

The present gage is a temporary vertical rod, which was intended for low-water observations, attached to a cypress tree at the right edge of the water 150 feet above the bridge. It was read by J. M. Johnson until December 1, 1905. The bench mark is the top of the downstream end of the second floor beam from the left end of the bridge; elevation, 23.00 feet above the datum of the gage.

Discharge data at this station are contained in Water-Supply Paper of the United States Geological Survey, No. 98, p. 128.

Discharge measurements of Kinchafoonee Creek near Leesburg, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 30	F. A. Murray	90	180	1.20	0.98	216
October 13	W. E. Hall	90	238	1.35	1.70	323

Daily gage height, in feet, of Kinchafoonee Creek near Leesburg, Ga., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.0	1.8	1.45	1.7	17		1.1	1.4	1.8	
2		1.0	3.0	1.35		18		1.0	1.35	1.6	
3		1.1	2.9	1.3		19		1.0	1.3	1.55	
4		1.3	2.6	1.25		20		.9	1.25	1.5	
5		1.5	2.4	1.2		21		.8	1.2	1.4	
6		1.3	2.0	1.2		22		.8	1.2	1.4	
7		1.2	1.9	1.2		23		.7	1.2	1.4	
8		1.1	1.8	1.2		24		.7	1.2	1.4	
9		1.0	1.7	1.2		25		.7	1.2	1.4	
10		1.0	1.6	1.3		26		.6	1.2	1.5	
11		.9	1.6	1.9		27		.6	1.3	1.6	
12		.8	1.7	1.3		28		.6	1.5	1.7	
13		.7	1.8	2.8		29		.8	1.55	1.8	
14		.8	1.9	2.5		30	1.0	1.0	1.5	1.7	
15		.9	1.7	2.3		31	1.0		1.5		
16		1.0	1.6	2.0							

ICHAWAYNOCHAWAY CREEK AT MILFORD, GA.

This station was established August 29, 1905, by F. A. Murray. It is located at the wagon bridge at Milford, Ga., 9 miles east of Leary, Ga., the railway point from which it is reached.

The channel is straight for 800 feet above and below the bridge. The current is moderately swift and is smooth except where it is broken by the bridge bents.

Discharge measurements are made from the downstream side of the bridge, an old wooden structure supported by bents, six of which are in the water at ordinary stages. The initial point for soundings is the end of the hand rail at the left bank, downstream side.

The present gage is a temporary staff for low-water observations attached to the downstream post of the first bent from the left bank. It is read once each day by W. J. Kidd. Bench marks were established as follows: (1) The top of the upstream cap of the first bent from the left bank; elevation, 15.00 feet. (2) A nail in a cypress tree at the left edge of the water, 30 feet below the bridge; elevation, 10.00 feet. Elevations refer to the datum of the gage.

Discharge measurements of Ichawaynochaway Creek at Milford, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 29	F. A. Murray	111	458	0.79	2.89	364
October 16	W. E. Hall	116	452	.85	3.05	386

Daily gage height, in feet, of Ichawaynochaway Creek at Milford, Ga., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.8	3.2	3.05	2.95	17	.....	2.8	3.05	3.55	4.05
2	.....	2.8	3.4	3.0	2.9	18	.....	2.75	3.2	3.5	4.0
3	.....	2.8	3.5	3.0	2.9	19	.....	2.7	3.2	3.4	4.0
4	.....	2.75	3.6	3.0	2.95	20	.....	2.65	3.1	3.3	4.15
5	.....	2.7	3.6	3.1	3.0	21	.....	2.6	3.1	3.25	4.7
6	.....	2.7	3.7	3.1	3.1	22	.....	2.6	3.0	3.2	5.0
7	.....	2.65	3.7	3.15	3.25	23	.....	2.55	3.1	3.15	5.5
8	.....	2.6	3.5	3.25	3.4	24	.....	2.55	3.2	3.1	6.0
9	.....	2.6	3.1	3.35	3.5	25	.....	2.5	3.35	3.05	5.9
10	.....	2.55	3.15	3.4	3.6	26	.....	2.5	3.5	3.0	5.4
11	.....	2.55	3.2	3.45	3.65	27	.....	2.5	3.45	3.0	4.9
12	.....	2.7	3.3	3.5	3.7	28	.....	2.45	3.3	3.0	4.9
13	.....	2.9	3.4	3.55	3.9	29	2.9	2.62	3.2	3.0	4.7
14	.....	3.0	3.4	3.6	4.0	30	2.85	2.92	3.15	3.0	4.5
15	.....	3.0	3.2	3.6	4.05	31	2.8	.....	3.05	.....	4.4
16	.....	2.9	3.0	3.6	4.05						

MISCELLANEOUS MEASUREMENTS IN APALACHICOLA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Apalachicola River drainage basin during 1905:

Blue Spring near Albany, Ga.—This spring is located about 4 miles below Albany, Ga., on the county road leading to Hardaway. A measurement was made of the two channels through which the water flows from the spring April 26, 1905.

Width, 33 feet; area, 30 square feet; mean velocity, 2.30 feet per second; discharge, 69 second-feet.

Buck Creek near Montezuma, Ga.—This stream enters Flint River from the right about 1 mile west of Montezuma, Ga. A measurement was made August 23, 1905, at an old tramroad trestle about 1 mile above the mouth of the creek. The bench mark is the top of the upstream end of the cap of the first bent from the left edge of the stream; elevation, 12.00 feet above the datum of the assumed gage.

Width, 49 feet; area, 118 square feet; mean velocity, 1.42 feet per second; gage height, 2.20 feet; discharge, 167 second-feet.

Chattahoochee River near Columbus, Ga.—A measurement was made September 25, 1905, from a boat held by cable stretched across the channels of the river about 8 miles upstream from Columbus and about 1½ miles above the mouth of Standingboy Creek. The bench mark is the top of a large wire nail which is driven into the base of an ash tree which stands about 25 feet below Narramore's spring branch; elevation, 5.00 feet above the datum of the assumed gage.

Width, 282 feet; area, 1,150 square feet; mean velocity, 0.98 foot per second; gage height, 1.75 feet; discharge, 1,125 second-feet.

Chickasawhachee Creek near Newton, Ga.—A measurement was made August 26, 1905, at McRainey Bridge, about 10 miles west of Newton, Ga. The initial point for soundings is the end of the bridge at the left bank, downstream side. The bench mark is the top of the downstream end of the middle bent of the bridge; elevation, 12.50 feet above the datum of the assumed gage.

Width, 35 feet; area, 38 square feet; mean velocity, 0.92 foot per second; gage height, 0.80 foot; discharge, 35 second-feet.

Coolawahee Creek near Newton, Ga.—A measurement was made August 28, 1905, from the downstream side of a wooden wagon bridge about 1 mile north of Newton, Ga. The bench mark is the top of the downstream end of the floor plank at a point 1 foot to the left of the center post; elevation, 11.50 feet above the datum of the assumed gage.

Width, 23 feet; area, 24 square feet; mean velocity, 1.62 feet per second; gage height, 0.70 foot; discharge, 25.5 second-feet.

Elkins Creek near Thunder, Ga.—Measurements were made during 1905 at a wooden wagon bridge 1 mile north of Thunder, Ga., about 200 feet below a small gristmill. As the flow at low water depends on the operation of the mill, the measured discharges do not give the natural flow of the stream. The bench mark is a notch and copper nails on the upstream main brace of the truss of the bridge, 8½ feet from the left end of the truss; elevation, 24.00 feet above the datum of the assumed gage.

April 21: Width, 42 feet; area, 38 square feet; mean velocity, 1.79 feet per second; gage height, 2.07 feet; discharge, 68 second-feet.

September 27: Width, 28 feet; area, 10 square feet; mean velocity, 0.73 foot per second; gage height, 1.45 feet; discharge, 7.3 second-feet.

Flint River near Thomaston, Ga.—A measurement was made September 20, 1905, at Parkers Bridge, about 7 miles west of Thomaston, Ga. The bench mark is the top of the upstream end of the first floor beam from the middle pier in the first iron span from the right bank; elevation, 35.00 feet above the datum of the assumed gage.

Width, 136 feet; area, 158 square feet; mean velocity, 1.39 feet per second; gage height, 5.00 feet; discharge, 219 second-feet.

Flint River near Woodbury, Ga.—A measurement was made April 21, 1905, from the downstream side of Powells Bridge, about 5 miles above the regular gaging station near Woodbury, Ga. The bench mark is the top of the right upstream post of the first pier from the right bank; elevation, 15 feet above the datum of the assumed gage.

Width, 143 feet; area, 479 square feet; mean velocity, 1.05 feet per second; gage height, 5.47 feet; discharge, 502 second-feet.

Hazel Creek near Demorest, Ga.—Measurements were made from the upstream side of a wooden highway bridge 1 mile north of Demorest, on the Porter Mills road. The bench mark is the top of the upstream end of the second crossbeam from the right-bank end of the bridge; elevation, 15.00 feet above the datum of the assumed gage.

September 5: Width, 27 feet; area, 24 square feet; mean velocity, 1.37 feet per second; gage height, 0.82 foot; discharge, 33 second-feet.

October 23: Width, 27 feet; area, 20 square feet; mean velocity, 1.15 feet per second; gage height, 0.71 foot; discharge, 23 second-feet.

Ichawaynochaway Creek at Barnetts Bridge, near Newton, Ga.—A measurement was made August 26, 1905, from the downstream side of Barnetts Bridge, 10 miles southwest of Newton, Ga. The initial point for soundings is the left end of the bridge approach, downstream side. The bench mark is the top of the downstream end of the second iron crossbeam from the left-bank pier; elevation, 29.50 feet above the datum of the assumed gage.

Width, 84 feet; area, 196 square feet; mean velocity, 2.62 feet per second; gage height, 1.30 feet; discharge, 513 second-feet.

Ichawaynochaway Creek at Rentz Bridge, near Newton, Ga.—A measurement was made August 26, 1905, from the downstream side of Rentz Bridge, about 12 miles west of Newton, Ga. The initial point for soundings is the end of the downstream hand rail at the left bank. The bench mark is the top of the downstream end of the cap of the bent which stands in the middle of the creek; elevation, 14.50 feet above the datum of the assumed gage.

Width, 76 feet; area, 355 square feet; mean velocity, 1.31 feet per second; gage height, 2.20 feet; discharge, 465 second-feet.

Ichawaynochaway Creek near Williamsburg, Ga.—A measurement was made April 27, 1905, at the Central of Georgia Railway bridge, 1¼ miles from Williamsburg, Ga. The bench mark is the top of the downstream end of the third bent from the left bank; elevation, 20.00 feet above the datum of the assumed gage.

Width, 92 feet; area, 727 square feet; mean velocity, 1.06 feet per second; gage height, 7.66 feet; discharge, 767 second-feet.

Red Oak Creek near Woodbury, Ga.—This stream enters Flint River from the right, 5 miles above the regular gaging station on Flint River near Woodbury, Ga. A measurement was made September 27, 1905, at a wooden wagon bridge about 1 mile above the mouth of the creek. The bench mark is the top of the first post from the right-bank edge, downstream side, 15 feet from a large white-oak tree; elevation, 20.00 feet above the datum of the assumed gage.

Width, 32 feet; area, 12 square feet; mean velocity, 0.83 foot per second; gage height, 2.25 feet; discharge, 10 second-feet.

Warm Springs at Warm Springs, Ga.—These springs are located one-half mile from Warm Springs, Ga., a station on the Southern Railway. Two discharge measurements were made March 10, 1905, about 300 feet below the springs and about 75 feet above the mouth of the branch, which is formed by the united flow of the several springs. April 20, 1905, two measurements were made about 6 feet below the end of the stone walls at the outlet from the bath house.

March 10: Width, 5 feet; area, 2.8 square feet; mean velocity, 1.14 feet per second; discharge, 3.2 second-feet.

April 20: Width, 4 feet; area, 1.52 square feet; mean velocity, 0.97 foot per second; discharge, 1.47 second-feet.

April 20: Width, 2.6 feet; area, 2.12 square feet; mean velocity, 0.69 foot per second; discharge, 1.48 second-feet.

Whitewater Creek near Montezuma, Ga.—This stream enters Flint River from the right. A measurement was made August 31, 1905, from the downstream side of a wooden highway bridge, locally known as the Lower Whitewater Bridge, about 4 miles northwest of Montezuma, Ga. The bench mark is the top of the downstream end of the cap of the third bent from the right bank; elevation, 12.00 feet above the datum of the assumed gage.

Width, 71 feet; area, 275 square feet; mean velocity, 0.94 foot per second; gage height, 2.14 feet; discharge, 260 second-feet.

CHOCTAWHATCHEE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Choctawhatchee River drains the southeastern part of Alabama and that portion of Florida lying immediately south. The main river rises in Barbour County, Ala., a short distance west of Eufaula, Ala., and flows in a southwesterly and southerly direction through Choctawhatchee Bay to the Gulf of Mexico. Pea River is the principal tributary and enters from the west at Geneva, Ala. This branch is the longer of the two, measured above their junction, having its head in Bullock County, near Union Springs, Ala. Double Bridges Creek is an important but small tributary lying between the main branches and entering Choctawhatchee River just above the mouth of Pea River. These are all moderately swift streams, even at low water, and at places the fall is sufficient to make considerable shoals or rapids and offer practicable sites for water-power developments.

The following pages give the results of the data collected in this drainage during 1905.

CHOCTAWHATCHEE RIVER NEAR GENEVA, ALA.

This station was established August 26, 1904, by M. R. Hall. It is located at a wagon bridge about 1 mile from Geneva and one-fourth mile from Eunola, Ala. The station is about three-fourths mile above the mouth of Double Bridges Creek, and is also near the junction with Pea River. Backwater from both of these streams will affect the gage heights during times of unequal rise, and the station was maintained only temporarily for low-water measurements. Daily gage readings were discontinued December 31, 1904, since which time the station has been maintained for miscellaneous low-water measurements.

The channel is straight for 200 feet above and for one-half mile below the bridge. The current has a fair velocity. The right bank is a sand bluff about 27 feet high. There are a few trees on the face of the bluff and the top is wooded. The left bank is an overhanging rock cliff to a height of about 10 feet, above which it is sandy, and slopes gradually to a total height of about 27 feet. The bed of the stream is composed of firm sand for the greater part, there being some rock at the left bank, and is clean and permanent. There is but one channel at all but very high stages, when both banks overflow and a second channel is formed by lower ground some distance from the river on the right bank.

Discharge measurements are made from the downstream side of the three-span drawbridge, having about 50 feet of trestle approach on either end. The initial point for soundings is the left end of the iron bridge on the downstream side.

The gage is a vertical scale, reading from 1 to 9 feet, and continued on the timber to which it is attached. This timber is fastened to the upstream side of a heavy pile which was a part of the right bent of an old bridge that occupied the site of the present one. This pile is the second from the downstream end of a line of five set up and down stream. Bench marks were established as follows: (1) The top of the downstream end of the fourth floor beam from the right end of the bridge, this being the first beam from the left end of the span; elevation, 32.00 feet. (2) A large wire nail in the river side of a cypress tree on the right bank about 140 feet below the bridge; elevation, 12.07 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 121-122.

Discharge measurements of Choctawhatchee River near Geneva, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 29	J. M. Giles	118	1,215	1.83	6.05	2,223
June 14	W. E. Hall	117	1,134	1.25	5.50	1,416

DOUBLE BRIDGES CREEK AT GENEVA, ALA.

This station was established August 26, 1904, by M. R. Hall. It is located at the wagon bridge on the outskirts of Geneva, Ala., about three-fourths of a mile above the mouth of the creek. During high water the gage heights are affected by backwater from Choctawhatchee River, and the station was maintained only temporarily for low-water measurements. Daily gage readings were discontinued December 31, 1904, since which time the station has been maintained for miscellaneous low-water measurements.

The channel is curved for about 200 feet above and straight for about 600 feet below the station. The current has a good velocity. Both banks are about 15 or 17 feet high, wooded except at the bridge, and are subject to overflow. The bed of the stream is composed of sand and is clean except near the right bank, where a half-buried tree forms an obstruction. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the single-span iron bridge. The initial point for soundings is the upstream side of the left end of the bridge.

The gage is a vertical staff fastened to the upstream side of a cypress tree on the left bank, about 100 feet below the bridge. Bench marks were established as follows: (1) The bottom of the upstream end of the first floor beam from the left end of the bridge; elevation, 19.80 feet. (2) A chisel cut and white-paint mark on the intermediate post 6 feet above bench mark No. 1; elevation, 25.80 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 122–123.

Discharge measurements of Double Bridges Creek at Geneva, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 29	J. M. Giles	55	156	1.45	3.15	227
June 14	W. E. Hall	60	268	1.93	4.25	518

PEA RIVER AT PERA, ALA.

This station was established August 27, 1904, by M. R. Hall. It is located at the Elton wagon bridge, about one-half mile west of Pera, Ala., a station on the Georgiana and Graceville branch of the Louisville and Nashville Railroad.

The channel curves to the left about 150 feet above the station, which tends to throw the greatest current velocity along the right bank, and is straight below the station for about 1,000 feet The current has a fair velocity. The right bank is composed of rock, vertical for about 20 feet from low-water level, and is free from vegetation. The left bank is composed of sand and mud, rising gradually. It is wooded above and below, but cleared at the bridge. Both banks are subject to overflow during extreme high water. The bed of the stream is composed of smooth rock toward the right bank and sand toward the left. There is one channel at all stages.

Discharge measurements are made from the downstream side of the single-span bridge. The initial point for soundings is the outside of the downstream tubular iron pier at the right bank.

A standard chain gage is fastened to the top plank of the upstream railing of the bridge, with the pulley end of the box abutted against the intermediate post over the second floor beam from the right bank; length of chain, 48.20 feet. The gage is read once each day by W. G. Early, who is paid by the Alabama Geological Survey. Bench marks were established as follows: (1) The top of the downstream end of the first floor from the right pier; elevation, 42.00 feet. (2) A chisel mark on the intermediate post at the downstream end of the first floor beam from the right bank, 5 feet above bench mark No. 1; elevation, 47.00 feet. (3) The top of the upstream end of the second floor beam from the right bank;

elevation, 42.03 feet. (4) A chisel mark on the post 4.97 feet above bench mark No. 3; elevation, 47.00 feet. (5) A chisel mark on the iron cap of the downstream tubular pier at the right end of the bridge; elevation, 41.04 feet. (6) A wire nail in a cut on the root of a large water-oak tree on the left bank, about 50 feet from the river and 40 feet above the end of the bridge approach; elevation, 34.73 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 123–124.

Discharge measurements of Pea River at Pera, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 28	J. M. Giles	89	686	2.14	6.81	1,468
March 28	do	89	687	2.14	6.84	1,473
March 30	do	84	617	1.97	6.13	1,213
March 30	do	84	620	1.98	6.14	1,225
June 15	W. E. Hall	73	456	1.27	3.99	579
June 15	do	73	456	1.32	4.00	604
October 18	do	75	425	1.27	4.07	638

Daily gage height, in feet, of Pea River at Pera, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.6	5.0	8.1	5.7	4.6	5.4	5.9	5.2	3.0	5.3	3.1	3.2
2	5.2	4.9	7.6	5.6	4.9	5.9	5.0	10.9	2.9	4.6	3.0	3.3
3	4.7	4.8	7.5	5.4	4.4	5.8	4.6	8.4	2.6	4.6	3.0	7.4
4	4.4	4.6	7.3	5.2	4.7	5.0	4.3	7.1	5.8	4.0	2.9	12.0
5	4.1	4.7	7.1	5.8	4.7	4.7	3.9	6.7	5.6	3.7	2.7	8.7
6	4.1	6.1	6.9	9.6	4.6	4.4	3.9	5.6	3.5	3.4	2.7	8.6
7	6.0	7.0	6.7	8.0	4.3	3.8	3.2	4.2	3.1	3.5	3.4	7.7
8	4.9	9.4	6.7	7.4	4.1	3.3	2.9	3.5	2.8	3.0	3.3	6.6
9	4.6	14.7	6.6	6.6	4.3	3.2	2.8	4.1	2.6	2.9	3.0	8.5
10	4.3	15.2	9.2	6.0	4.4	3.0	3.0	4.0	2.5	3.7	3.1	8.7
11	4.1	12.1	9.0	6.0	4.3	2.7	5.3	6.3	2.4	7.1	4.4	8.6
12	4.0	16.2	9.3	8.6	4.0	2.6	5.0	7.5	2.4	6.1	4.5	8.6
13	9.0	22.5	10.1	14.2	3.9	2.5	4.2	8.7	5.1	4.9	4.4	7.8
14	11.7	26.0	9.5	15.2	3.5	2.8	3.4	7.6	4.8	4.7	4.4	8.5
15	8.8	27.1	8.7	14.1	3.7	3.9	3.0	6.8	3.5	3.9	4.1	10.1
16	7.6	29.4	7.7	11.5	8.7	3.4	2.8	6.1	3.5	4.9	3.9	9.4
17	6.9	28.8	7.4	9.2	13.3	3.0	2.8	6.6	2.9	4.5	3.8	8.4
18	6.3	24.0	7.2	7.8	10.3	3.0	3.0	7.4	2.8	4.0	3.6	7.6
19	6.0	18.8	7.1	7.0	8.2	3.9	3.0	7.4	2.7	3.7	3.2	6.8
20	5.9	13.9	6.8	6.4	7.0	3.7	2.6	7.0	2.8	3.4	3.1	9.1
21	5.6	12.5	10.8	6.0	6.1	5.7	2.4	6.7	2.4	3.3	3.1	18.8
22	5.1	12.0	9.6	5.8	5.3	4.5	2.2	5.0	2.3	3.1	3.1	19.8
23	4.9	11.0	8.7	5.5	4.9	3.4	2.1	4.4	2.3	3.0	3.0	18.8
24	5.0	10.3	8.3	5.5	4.3	3.2	2.1	3.8	2.1	2.8	3.0	20.7
25	8.5	9.7	8.6	5.4	5.9	3.1	2.6	3.6	2.1	2.7	3.0	22.4
26	6.6	9.4	7.9	5.5	5.7	2.9	2.9	5.4	2.0	3.0	3.7	22.8
27	5.9	8.8	7.4	5.5	6.2	2.7	3.3	6.1	2.1	3.3	3.7	16.6
28	5.4	8.5	6.8	5.0	5.9	2.7	2.6	5.1	2.0	3.4	3.7	13.7
29	5.2	.....	6.4	4.7	5.3	3.7	3.4	4.0	2.3	3.3	3.5	13.5
30	5.2	.....	6.1	4.5	4.7	6.2	4.2	3.5	2.8	3.3	3.4	12.2
31	5.1	.....	5.9	.....	5.1	.....	4.3	3.3	.....	3.2	.....	10.7

Station rating table for Pea River at Pera, Ala., from August 27, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	150	2.70	360	4.20	656	6.20	1,245
1.30	160	2.80	378	4.30	680	6.40	1,315
1.40	171	2.90	396	4.40	704	6.60	1,385
1.50	182	3.00	414	4.50	728	6.80	1,460
1.60	194	3.10	432	4.60	754	7.00	1,540
1.70	206	3.20	450	4.70	780	7.20	1,620
1.80	218	3.30	468	4.80	806	7.40	1,700
1.90	230	3.40	488	4.90	834	7.60	1,780
2.00	242	3.50	508	5.00	862	7.80	1,860
2.10	258	3.60	528	5.20	920	8.00	1,940
2.20	274	3.70	548	5.40	980	8.20	2,030
2.30	290	3.80	568	5.60	1,040	8.40	2,120
2.40	306	3.90	590	5.80	1,105	8.60	2,210
2.50	324	4.00	612	6.00	1,175	8.80	2,300
2.60	342	4.10	634				

The above table is based on discharge measurements made during 1904–1905. It is well defined between gage heights 4 feet and 7 feet. Above 7 feet the curve is uncertain. High-water estimates are rough approximations. Above gage height 8.8 feet the rating curve is a tangent, the difference being 50 per tenth.

Estimated monthly discharge of Pea River at Pera, Ala., for 1904–1905.

[Drainage area, 1,180 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 27-31	1,740	780	1,369	1.16	0.216
September	950	171	375	.318	.355
October	258	150	176	.149	.172
November	342	160	267	.226	.252
December	1,940	274	791	.670	.772
1905.					
January	3,750	612	1,186	1.01	1.16
February	12,600	754	4,745	4.02	4.19
March	3,300	1,140	1,910	1.62	1.87
April	5,500	728	1,779	1.51	1.68
May	4,550	508	1,115	.945	1.09
June	1,245	324	600	.508	.567
July	1,140	258	517	.438	.505
August	3,350	468	1,214	1.03	1.19
September	1,105	242	431	.365	.407
October	1,580	360	606	.514	.593
November	728	360	499	.423	.472
December	9,300	450	3,623	3.07	3.54
The year	12,600	242	1,519	1.29	17.26

MISCELLANEOUS MEASUREMENTS IN CHOCTAWHATCHEE RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Choctawhatchee River drainage basin during 1905:

Choctawhatchee River near Elba Junction, Ala.—A measurement was made October 17, 1905, from the downstream side of the Atlantic Coast Line bridge near Elba Junction, Ala. The initial point for soundings is the right end of the bridge on the dowstream side. The bench mark is the top of the downstream end of the first floor beam from the right end of the bridge; elevation, 40.00 feet above the datum of the assumed gage.

Width, 93 feet; area, 582 square feet; mean velocity, 0.74 foot per second; gage height, 5.53 feet discharge, 430 second-feet.

Pea River at Elba, Ala.—A measurement was made October 17, 1905, from the downstream side of a single-span iron highway bridge at Elba, Ala. The initial point for soundings is the center of the downstream pier at the right end of the bridge. The bench mark is a chisel mark and the letters "B. M." cut in the top of the outer member of the downstream chords between the second and third floor beams at a point 45 feet from the initial point for soundings; elevation, 48.00 feet above the datum of the assumed gage.

Width, 100 feet; area, 202 square feet; mean velocity, 2.25 feet per second; gage height, 3.59 feet; discharge, 455 second-feet.

Whitewater River near Elba, Ala.—This stream enters Pea River from the right. It was measured October 17, 1905, from the downstream side of an iron highway bridge near Elba, Ala., 150 feet above the mouth of the river. The bench mark is the center of a steel pin which connects the second downstream vertical post from the right end of the bridge to the second floor beam; elevation, 42.44 feet above the datum of the assumed gage.

Width, 58 feet; area, 148 square feet; mean velocity, 1.57 feet per second; gage height, 3.59 feet; discharge, 232 second-feet.

ESCAMBIA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Escambia River drains the south-central portion of Alabama and empties into the Gulf of Mexico through Escambia Bay and Pensacola Bay. Conecuh River joins the Escambia about 5 miles south of the Alabama-Florida State line, and is very much the larger of the two branches. Conecuh River rises in Bullock County, Ala., very close to the headwaters of Pea River in the Choctawhatchee drainage, and flows southwestward throughout its course. Pigeon and Patsaliga creeks, both from the west, are the principal tributaries of Conecuh River. The Conecuh and its tributaries are swift streams and at places there are rocky shoals and rapids.

The following pages give the results of the data collected in this drainage during 1905.

CONECUH RIVER AT BECK, ALA.

This station was established August 24, 1904, by M. R. Hall. It is located at Simmons Bridge at Beck, Ala., about 12 miles below the mouth of Patsaliga Creek. The nearest railway station is Andalusia, Ala., 8 miles east, on the Central of Georgia and Louisville and Nashville railways.

The channel is straight for 600 feet above and for one-half mile below the station. The current is fairly swift. Both banks are steep. The right bank is composed of rock to a height of about 8 feet, then earth covered with bushes to a total height of about 30 feet, and is subject to overflow. The left bank is composed of rock to a height of from 15 to 20 feet, then earth covered with bushes to a total height of about 35 feet, and overflows only at extreme high water. The bed of the stream is composed of fine sand, there being some smooth rock along the left bank. There are some sunken logs in the section which obstruct the current to some extent. There is one channel at all stages.

Discharge measurements are made from the upstream side of the iron bridge. The bridge consists of a main span of 125 feet, with a 50-foot span at each end. The approach on the right bank is 50 feet of wooden and 90 feet of iron trestle; on the left bank 20 feet of wooden trestle. The initial point for soundings is the end of the iron bridge, at the left bank on the upstream side.

A standard chain gage is fastened to the channel-iron railing post which is riveted to the upstream end of the first floor beam of the main span, 72 feet from the initial point for soundings; length of chain, 53.50 feet. The gage is read once each day by W. R. Duggan, who is paid by the Alabama Geological Survey. Bench marks were established as follows: (1) The top of the upstream end of the first iron floor beam of the main span from the left pier; elevation, 47.50 feet. (2) The top of the iron channel-bar post to which the gage is fastened: elevation, 52.17 feet. (3) A cross chisled on the upper side of the upstream tubular pier at the left end of the main span; elevation, 47.13 feet. (4) A copper plug set in the concrete filling of the short tubular pier at the left end of the iron bridge, downstream side; elevation, 42.21 feet. Elevations refer to datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 125–126.

Discharge measurements of Conecuh River at Beck, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 27	J. M. Giles	121	686	2.42	5.03	1,658
March 31	do	117	521	2.02	3.77	1,055
June 13	W. E. Hall	108	249	1.16	1.43	288
October 19	do	114	332	1.23	2.03	408

Daily gage height, in feet, of Conecuh River at Beck, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.4	3.5	5.7	3.6	2.6	4.7	2.7	1.75	1.8	1.1	1.65	2.0
2	3.4	3.4	5.4	3.6	2.55	3.0	3.0	4.1	1.7	1.1	1.6	2.2
3	3.1	3.2	5.2	3.4	2.45	3.0	2.4	2.85	1.5	1.4	1.6	4.6
4	2.7	3.3	4.9	3.3	2.5	2.95	2.2	2.9	1.8	1.7	1.6	3.4
5	2.5	3.2	4.8	3.9	2.45	2.9	2.1	3.0	1.8	1.75	1.5	4.0
6	2.7	4.6	4.7	4.0	2.35	2.9	2.0	2.7	2.05	1.75	1.5	4.4
7	3.0	5.0	4.6	3.9	2.3	2.75	1.8	2.35	1.8	1.7	1.55	4.2
8	3.4	7.4	4.4	3.8	2.2	2.7	1.75	2.0	1.7	1.6	1.4	4.0
9	3.0	10.8	4.6	3.5	3.0	2.6	1.7	2.4	1.65	1.7	1.35	3.8
10	3.2	10.6	4.6	3.8	2.35	2.3	1.7	2.7	1.45	2.4	1.5	3.5
11	2.9	9.0	4.8	3.4	2.2	1.8	2.7	2.1	1.4	3.6	2.4	3.5
12	3.4	15.6	5.5	4.2	2.5	1.7	2.4	3.4	1.4	3.1	2.2	3.7
13	5.6	20.2	5.6	7.0	2.2	1.5	2.15	4.4	2.0	3.0	2.3	3.8
14	5.8	21.9	5.6	6.8	2.05	1.9	1.85	3.8	1.7	2.9	2.7	4.2
15	5.3	22.5	5.3	5.8	3.6	2.3	1.8	3.6	1.65	2.5	2.4	4.4
16	5.1	21.6	5.3	5.8	5.8	1.8	1.8	4.9	2.0	2.2	2.3	4.5
17	4.9	23.3	5.0	5.7	5.3	1.75	1.85	4.3	1.9	2.0	2.2	4.7
18	4.4	24.1	4.8	5.7	5.5	1.7	2.0	4.3	1.6	2.1	2.1	4.7
19	4.6	21.1	4.5	5.5	5.0	1.7	1.6	4.1	1.7	1.85	2.0	4.6
20	4.1	19.5	5.3	4.6	4.5	2.5	1.4	3.9	1.7	2.0	1.9	7.1
21	3.9	13.2	6.0	3.6	4.0	1.9	1.2	3.8	1.5	2.3	1.9	8.9
22	3.7	10.8	6.0	3.4	3.6	1.85	1.2	3.8	1.4	1.8	1.85	8.3
23	3.5	9.1	6.0	3.2	3.7	2.0	1.2	3.6	1.35	1.6	1.7	8.1
24	4.3	8.2	6.0	3.2	3.6	2.25	1.2	2.4	1.2	1.6	1.7	9.0
25	4.5	7.5	5.6	3.0	4.5	2.1	1.5	2.2	1.2	1.55	1.65	8.9
26	4.8	6.7	5.6	2.95	3.1	2.05	1.6	2.4	1.1	2.0	1.6	8.5
27	4.3	6.4	5.2	2.85	3.1	2.15	1.4	2.2	1.1	1.7	1.6	8.4
28	3.9	6.0	4.6	2.75	3.1	3.5	1.35	2.4	1.05	1.7	1.9	10.0
29	3.8	.....	4.2	2.75	3.1	3.0	1.4	2.4	1.2	1.75	2.0	10.4
30	3.7	.....	4.0	2.65	3.0	4.2	2.0	2.2	1.3	1.8	2.0	9.3
31	3.6	.....	3.8	.....	3.4	.....	2.4	2.0	.....	1.7	.....	8.2

Station rating table for Conecuh River at Beck, Ala., from August 24, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	187	2.00	395	3.20	800	4.40	1,340
0.80	197	2.10	418	3.30	840	4.50	1,390
0.90	208	2.20	443	3.40	885	4.60	1,440
1.00	220	2.30	470	3.50	930	4.70	1,490
1.10	233	2.40	500	3.60	975	4.80	1,540
1.20	247	2.50	530	3.70	1,020	4.90	1,590
1.30	262	2.60	565	3.80	1,065	5.00	1,640
1.40	278	2.70	600	3.90	1,110	5.20	1,750
1.50	295	2.80	640	4.00	1,155	5.40	1,860
1.60	313	2.90	680	4.10	1,200	5.60	1,970
1.70	332	3.00	720	4.20	1,245	5.80	2,080
1.80	352	3.10	760	4.30	1,290	6.00	2,190
1.90	373						

The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 1.2 feet and 5 feet. Above 6 feet the table is uncertain. High-water estimates are rough approximations. Above gage height 6 feet the rating curve is a tangent, the difference being 60 per tenth.

Estimated monthly discharge of Conecuh River at Beck, Ala., for 1904–5.

[Drainage area, 1.290 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 24–31	2,025	680	1,176	0.912	0.271
September	1,832	220	454	.352	.393
October	262	187	210	.163	.188
November	362	197	282	.219	.244
December	1,340	295	601	.466	.537
1905.					
January	2,080	530	1,123	.871	1.00
February	13,050	800	5,537	4.29	4.47
March	2,190	1,065	1,698	1.32	1.52
April	2,790	582	1,221	.947	1.06
May	2,080	406	873	.677	.780
June	1,490	295	556	.431	.481
July	720	247	377	.292	.337
August	1,590	342	780	.605	.698
September	406	226	309	.240	.268
October	975	233	411	.319	.368
November	600	270	371	.288	.321
December	4,830	395	2,181	1.69	1.95
The year	13,050	226	1,286	.997	13.25

MOBILE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

This is the largest drainage basin in Georgia and Alabama, and is designated the Mobile basin because its waters all enter the Gulf through Mobile River at Mobile, Ala. It is formed as follows: Beginning at the headwaters, Cartecay and Ellijay rivers unite at Ellijay, Ga., to form Coosawattee River. Just above Resaca, Ga., this unites with the Conasauga to form Oostanaula River. At Rome, Ga., the Oostanaula and the Etowah unite to form Coosa River. Six miles above Montgomery, Ala., the Coosa and the Tallapoosa unite to form Alabama River, and not far from the coast the Tombigbee unites with the Alabama to form Mobile River, which flows into Mobile Bay, an arm of the Gulf of Mexico.

Cahaba River is the principal tributary of the Alabama and joins it about 10 miles below Selma. Hillabee Creek flows into Tallapoosa River just above Sturdevant and near Alexander. Talladega Creek is a tributary of the Coosa.

Tombigbee River rises in the northeastern part of Mississippi and enters Alabama in Pickens County. Its principal tributary is the Black Warrior, which is formed by the junction of Mulberry Fork and Sipsey Fork. Locust Fork enters the Black Warrior some distance below the junction.

The following pages give the results of the data collected in this drainage during 1905.

ALABAMA RIVER AT SELMA, ALA.

This station, which was originally established by the United States Engineer Corps, is now maintained by the United States Weather Bureau. It is located at the iron highway bridge one block from Water street, Selma, Ala.

The channel above the station is slightly curved for 1,000 feet and straight for 2,000 feet below the station. The velocity is good and the current is regular. The right bank is high

and rocky and will not overflow. The left bank is high, but overflows at extreme high water. The bed is mostly soft blue rock and the water is confined to one channel.

Discharge measurements are made from the bridge and the trestle approach on the left bank. The initial point for soundings is the end of the drawbridge on the right bank, upstream side.

The gage is in two sections. The first section, reading from −3 to +5.1 feet, is fastened to the lower side of the cofferdam on the second pier; the upper section, reading from 5.1 to 55 feet, is fastened to the draw pier. Bench marks were established as follows: (1) The top of the capstone of the pivot pier; elevation, 56.00 feet. (2) The edge of the coping on the right-bank abutment, just under the downstream side of the drawbridge; elevation, 59.51 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 36, p 155; 48, p 169; 65, p 282; 83, p 131; 98, pp 131-132; 127, pp 127-128.
Discharge: 48, p 169; 65, p 282; 98, p 132; 127, p 128.
Discharge, monthly: 75, p 92; 83, p 133; 98, p 134; 127, p 130.
Gage heights: 36, p 155; 48, p 170; 65, p 282; 83, p 131; 98, p 132; 127, p 129.
Hydrograph: 75, p 94.
Rating tables: 65, p 323; 83, p 132; 98, p 133; 127, p 129.

Discharge measurements of Alabama River at Selma, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage. height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 7 [a]	J. M. Giles	432	7,870	4.12	11.05	32,420
February 8 [a]	do	439	9,259	4.32	14.00	40,370
February 8 [a]	do	440	9,648	4.32	14.90	41,650
May 20	M. R. Hall	457	7,799	3.94	11.94	30,740
December 19	W. E. Hall	462	7,633	3.86	11.00	29,440

[a] Measurement made at Louisville and Nashville Railroad bridge during rapid rise of the river.

Daily gage height, in feet, of Alabama River at Selma, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.0	4.3	19.9	7.0	5.2	12.6	5.0	2.2	2.4	−1.4	0.8	0.0
2	6.9	6.0	17.0	6.4	6.0	10.4	6.8	2.5	2.4	−1.4	.8	.2
3	6.5	6.2	13.0	6.0	6.0	8.0	6.5	2.5	1.0	−1.4	.8	2.4
4	5.4	5.7	10.5	6.0	6.5	6.0	5.0	2.5	1.0	−1.2	.4	4.6
5	4.2	5.6	9.0	5.7	6.8	6.0	5.0	2.0	1.0	.8	.4	13.8
6	3.3	6.2	8.2	5.6	6.8	4.5	4.5	1.6	1.0	.0	.4	16.7
7	3.0	9.7	7.8	5.6	6.2	3.8	4.5	1.6	1.0	.0	.2	17.5
8	2.5	13.7	7.2	6.0	6.0	3.0	4.2	1.6	1.0	.9	.2	17.5
9	2.5	18.5	7.2	6.7	6.0	2.8	2.5	1.6	1.0	.9	.2	16.6
10	2.5	24.0	7.7	8.3	7.8	2.4	2.5	1.6	1.0	.9	.2	14.6
11	2.7	29.5	8.6	8.5	8.5	1.8	3.0	2.0	.8	1.1	.4	14.6
12	5.0	33.6	9.7	7.5	7.5	1.6	3.5	2.0	.6	1.4	.4	16.0
13	13.2	37.5	9.5	7.3	6.3	1.4	4.8	4.0	.6	1.4	.6	18.4
14	25.5	39.9	9.5	7.5	5.5	1.4	7.0	5.0	.4	1.4	1.0	19.0
15	30.3	41.4	9.5	8.1	5.0	1.4	7.6	8.4	.2	1.9	1.2	18.6
16	32.8	42.0	9.3	8.3	6.0	1.4	8.6	7.6	.0	2.9	1.2	16.4
17	33.0	41.4	8.5	8.3	8.2	1.4	8.4	7.6	− .4	3.0	1.2	12.6
18	33.0	39.2	7.8	7.9	11.4	1.4	7.6	8.5	− .4	3.0	1.0	11.0
19	27.0	34.7	7.2	7.0	12.0	1.4	4.8	9.5	.4	2.4	.6	9.5
20	22.1	29.3	8.0	6.0	12.0	2.0	4.5	10.0	.4	1.8	.6	10.5
21	17.0	22.2	13.5	5.6	11.3	2.5	3.5	9.6	.4	1.5	.6	12.6
22	10.6	17.6	20.9	5.5	10.0	2.5	3.0	8.7	.0	1.5	.6	17.9
23	8.5	17.4	23.0	5.3	10.0	2.5	1.6	7.4	− .2	1.5	.4	20.7
24	7.2	20.2	22.6	5.3	10.0	2.0	1.6	5.0	− .4	1.0	.2	23.6
25	7.0	21.9	20.0	5.1	10.0	2.0	1.6	4.7	− .4	.5	.2	25.0
26	6.6	22.4	16.3	5.0	12.8	1.5	1.6	4.5	− .6	.5	.2	25.4
27	5.8	22.2	13.6	4.8	13.8	2.0	1.6	4.3	−1.0	.5	.2	24.0
28	5.0	21.4	11.0	4.8	15.9	2.0	1.6	3.0	−1.4	1.0	.0	20.8
29	4.5	.....	9.5	4.8	16.8	2.0	1.6	2.8	−1.4	.5	.0	17.0
30	4.0	.....	8.2	5.0	17.3	2.5	1.6	2.6	−1.4	.5	.0	14.6
31	3.8	.....	7.6	.....	14.0	.....	1.6	2.6	.....	1.0	.....	13.5

Station rating table for Alabama River at Selma, Ala., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−2.00	3,000	.30	6,610	2.50	10,550	6.40	18,340
−1.90	3,150	.40	6,780	2.60	10,740	6.60	18,760
−1.80	3,300	.50	6,950	2.70	10,930	6.80	19,180
−1.70	3,450	.60	7,120	2.80	11,120	7.00	19,600
−1.60	3,600	.70	7,290	2.90	11,310	7.50	20,700
−1.50	3,750	.80	7,460	3.00	11,500	8.00	21,800
−1.40	3,900	.90	7,630	3.20	11,880	8.50	22,900
−1.30	4,050	1.00	7,800	3.40	12,260	9.00	24,000
−1.20	4,200	1.10	7,980	3.60	12,640	9.50	25,150
−1.10	4,350	1.20	8,160	3.80	13,020	10.00	26,300
−1.00	4,500	1.30	8,340	4.00	13,400	10.50	27,450
− .90	4,660	1.40	8,520	4.20	13,800	11.00	28,600
− .80	4,820	1.50	8,700	4.40	14,200	11.50	29,800
− .70	4,980	1.60	8,880	4.60	14,600	12.00	31,000
− .60	5,140	1.70	9,060	4.80	15,000	12.50	32,200
− .50	5,300	1.80	9,240	5.00	15,400	13.00	33,450
− .40	5,460	1.90	9,420	5.20	15,820	13.50	34,700
− .30	5,620	2.00	9,600	5.40	16,240	14.00	36,000
− .20	5,780	2.10	9,790	5.60	16,660	15.00	38,600
− .10	5,940	2.20	9,980	5.80	17,080	16.00	41,300
0.00	6,100	2.30	10,170	6.00	17,500	17.00	44,000
.10	6,270	2.40	10,360	6.20	17,920	18.00	46,700
.20	6,440						

The above table is fairly well defined to gage height 34 feet. It has been extended beyond this limit. Above gage height 18 feet the rating curve is a tangent, the difference being 275 per tenth.

Estimated monthly discharge of Alabama River at Selma, Ala., for 1905.

[Drainage area, 15,400 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	87,950	10,550	31,290	2.03	2.34
February	112,700	14,000	60,380	3.92	4.08
March	60,450	20,040	30,840	2.00	2.31
April	22,900	15,000	18,290	1.19	1.33
May	44,810	15,400	25,000	1.62	1.87
June	32,450	8,520	12,100	.786	.877
July	23,120	8,880	13,780	.895	1.03
August	26,300	8,880	14,660	.952	1.10
September	10,360	3,900	6,651	.432	.482
October	11,500	3,900	7,728	.502	.579
November	8,160	6,100	6,952	.451	.503
December	67,050	6,100	39,670	2.58	2.97
The year	112,700	3,900	22,280	1.45	19.47

ETOWAH RIVER NEAR BALLGROUND, GA.

This station was established in 1905 for the purpose of making a series of miscellaneous discharge measurements. It is located at an iron highway bridge about 2½ miles south of Ballground, Ga., and half a mile below the mouth of Long Swamp Creek.

The channel is nearly straight for 300 feet above and 600 feet below the station. The current is moderately swift and fairly good for measurement. The left bank is high and will not overflow, but the right bank is low and cultivated for about 500 feet and will overflow at a gage height of about 16 feet above low water. The bed of the river is partly rock.

Discharge measurements are made from the bridge of two iron spans. The left span is 110 feet long, and spans the entire river except at floods. The other span, which is over low ground on the right bank, is 100 feet long, and there is also 90 feet of wooden trestle on the right bank.

Gage heights are determined directly from the bench mark, which is the top of the upstream end of the first floor beam to the left of the middle pier; elevation, 28.00 feet above the datum of the assumed gage.

Discharge measurements of Etowah River near Ballground, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 24	O. P. Hall	81	314	2.43	3.10	763
November 15	M. R. Hall	78	239	1.71	2.24	408

ETOWAH RIVER AT CANTON, GA.

This station was established in 1892 by the United States Weather Bureau. Measurements were begun in 1896 by the United States Geological Survey. It is located at the wagon bridge in Canton, Ga., one-half mile above the mouth of Canton Creek and 1,000 feet upstream from the Atlanta, Knoxville and Northern Railway station.

The channel is straight for 1,000 feet above and 500 feet below the bridge. The current is affected by a fish-trap dam about 1 foot high, which has caused much trouble by being occasionally washed away and built up again. Up to gage height, 3 feet, the river is only 116 feet wide and flows between the piers on its lower banks. Up to about 14 feet it is confined between its upper banks, which are the abutments at the outer ends of the approaches. Above this point it begins to overflow the bottom lands. The bed is fairly constant.

Discharge measurements are made from the upstream side of the iron highway bridge. The initial point for soundings is the river side of the right-bank pier at the end of the main span.

The gage is a heavy vertical timber, fastened to the edge of the left-bank pier, on the upstream side. The gage is read once each day by J. M. McAfee, who is paid by the United States Weather Bureau for six months of the year and by the Georgia Geological Survey for the other six months. Bench marks were established as follows: (1) A cut on a silver-maple tree on the east side of the road, 20 feet from the end of the bridge, on the south or left bank of the river; elevation, 20.36 feet. (2) A cut on a persimmon tree 4 feet from the upper side of the bridge and 10 feet toward the river from the south end of the bridge; elevation, 16.88 feet. (3) The center of the head of a large wire nail, driven horizontally into the river side of a walnut tree on the east side of the road, 25 feet north of the north end of the bridge; elevation, 18.52 feet. (4) The top of the iron bar on the top of the left-bank pier at the end of the center span of the bridge, upstream side; elevation, 23.39 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 94-95; WS 15, p 48; 27, pp 47-48; 36, pp 143-144; 48, p 160; 65, p 275; 83, p 148; 98, pp 153-154; 127, pp 130-131, 175.

Discharge: Ann 18, iv, p 95; WS 15, p 48; 27, p 57; 36, p. 144; 48, p 160; 65, p 275; 83, p 149; 98, p 154; 127, p 131, 175.

Discharge, monthly: Ann 18, iv, p 96; 19, iv, p 242; 20, iv, pp 181, 189; 21, iv, p 145; 22, iv, p 193; WS 75, p 89; 83, p. 151; 98, p 156; 127, p 133.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: WS 11, pp 25-27; 15, p 48; 27, p 51; 36, p 144; 48, p 161; 65, p 276; 83, p 149; 98, p 155 127, p 132.

Hydrographs: Ann 18, iv, p 96; 19, iv, p 243; 20, iv, p 190; 21, iv, p 145; 22, iv, p 193.

Rainfall and run-off relation: Ann 20, iv, p 181.

Rating tables: Ann 18, iv, p 95; 19, iv, p 242; WS 27, p 58; 39, p 445; 52, p 514; 65, p 322; 83, p 150; 98, pp 155-156; 127, p 132.

Discharge measurements of Etowah River at Canton, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 21	J. M. Giles	112	545	1.30	0.67	720
January 21	B. S. Drane	112	545	1.30	.67	710
January 21	W. E. Hall	112	545	1.26	.67	689
April 20	O. P. Hall	113	502	1.43	.61	716
June 3	M. R. Hall	111	514	1.53	.49	786
October 18	do	106	449	1.18	.14	531
October 18	do	106	449	1.18	.14	531
November 17	do	108	445	.98	.14	434
November 17	do	108	445	.98	.14	434

Daily gage height, in feet, of Etowah River at Canton Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.5	0.5	0.7	0.7	0.8	0.6	1.7	0.5	0.2	0.5	0.1	0.3
2	.5	.5	.7	.7	.7	.6	1.0	.4	2.0	.4	.0	.3
3	.6	.5	.6	.7	.6	.5	.8	.3	.6	.4	.0	15.2
4	.5	.5	.6	.7	1.5	.5	.6	.2	.5	.3	.0	7.5
5	.5	.6	.6	.8	.9	.5	1.8	.2	.4	.3	.0	1.8
6	.6	.8	.7	.9	.9	.5	.7	.2	.3	.2	.0	1.2
7	1.4	1.2	.8	.9	2.5	.5	1.7	.2	.2	.2	.0	.9
8	.8	1.2	.8	.9	1.4	.5	.9	.4	.2	.1	.1	1.0
9	.7	3.7	.8	1.3	2.3	.4	1.7	.7	.1	.0	.1	6.5
10	.6	4.0	1.7	1.0	1.1	.4	2.1	.4	.1	.1	.2	3.4
11	.7	2.0	1.0	.7	.9	.4	7.0	2.0	.1	3.0	.3	1.8
12	9.4	1.5	1.0	1.0	.7	.4	4.0	2.5	.5	1.1	.2	1.0
13	10.0	4.8	.9	1.0	.7	1.2	2.0	2.0	.3	.4	.2	.8
14	2.2	2.8	.9	.7	.6	.5	1.5	1.0	.2	.2	.2	.6
15	1.0	1.8	.8	.7	1.0	.7	1.2	1.5	.0	.1	.1	.8
16	1.0	1.0	.8	1.0	4.0	.6	.9	1.0	.0	.3	.1	.7
17	.8	1.0	.7	.7	.9	.7	.7	.8	.0	.2	.1	.6
18	.8	.9	.7	.7	.8	.6	.5	.5	.0	.1	.1	.6
19	.8	.9	.7	.7	.7	.6	.5	.5	.0	.1	.1	.6
20	.7	1.8	.7	.6	.7	1.4	.7	.4	.0	.0	.2	.9
21	.7	9.9	3.0	.6	.7	2.3	.4	.4	.0	.0	.4	3.1
22	.6	3.9	1.5	.7	.7	3.7	.4	.3	.0	.0	.3	2.0
23	.6	2.0	1.0	.6	1.0	2.0	.4	.3	−.1	.0	.2	1.6
24	.5	1.3	1.0	.6	6.5	1.1	.4	.3	−.1	.0	.2	1.3
25	.5	1.0	.9	.6	1.9	.9	.4	.8	−.1	.1	.4	1.0
26	.5	.8	.9	.6	1.2	.9	.4	.4	−.1	.2	.5	.8
27	.5	.8	.9	.6	1.1	.8	.3	.3	−.1	.5	.3	.7
28	.5	.8	.8	.6	1.0	1.2	.3	.2	−.1	.3	.3	.7
29	.5	.....	.8	.6	.9	1.1	1.3	.2	.0	.2	.3	1.2
30	.6	.....	.8	1.3	.9	.9	.5	.2	.0	.1	.2	1.0
31	.6	.....	.8	.....	.8	.....	.7	.2	.....	.1	.....	.8

ETOWAH RIVER NEAR ROME, GA.

This station was established August 17, 1904, by M. R. Hall. It is located at Freemans Ferry, about 5 miles above Rome, Ga.

The channel is straight for about 3,000 feet above and 1,000 feet below the station. The current is swift. . There is a small shoal of rock about 50 feet below the gaging section. About 1,000 feet below there is an old fish-trap dam, but this has not been used for years, and is probably constant. Both banks are high, but are subject to overflow during high water. The bed of the stream is composed of small rock and pebbles, and is uniform and permanent. There is but one channel at all stages, the water being about 2.5 feet deep at low water.

Discharge measurements are made from a small boat, the meter being suspended from the ferry cable. Measurements can be made from the bridge at Rome, as no large quantity of water enters the river between the ferry and that place. Gage heights may be obtained at Rome by telephoning the observer. The initial point for soundings is the center of the windlass for the ferry cable on the left bank of the river.

The original gage, reading from 0 to 7 feet, is securely attached to a sycamore tree at left edge of river, about 250 feet below the ferry. A second section, reading from 7 to 20 feet, is attached to a post located 10 feet upstream from the first section and 10 feet from the edge of the river at low water. A third section, reading from 20 to 30 feet, is attached

to a maple tree opposite the post and 15 feet farther from the water's edge. The gage is read once each day by W. A. Gresham, who is paid by the Georgia Geological Survey. Bench marks were established as follows: (1) Head of lag screw driven into root of maple, to which gage 20 to 30 feet is attached; elevation, 19.26 feet. (2) Head of nail driven into root of maple tree 100 feet up river from gage; elevation, 22.18 feet. (3) Center mark on copper plug set horizontally in brick wall of F. B. Freeman's residence, on east end of house, near northeast corner, just below floor level; elevation, 27.99 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 98, pp 151-152; 127, pp 133-134.
Discharge: Ann 18, iv, p 109; 19, iv, p 252; WS 98, p 152; 127, p 134.
Discharge, monthly: WS 98, p 153; 127, p 135.
Gage heights: WS 98, p 152; 127, p 135.
Rating table: WS 98, p 153; 127, p 135.

Discharge measurements of Etowah River near Rome, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean. velocity.	Gage. height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 28	W. E. Hall	297	1,077	2.29	3.10	2,468
May 12	M.R. Hall	300	873	1.84	2.40	1,613
July 24	W. E. Hall	300	761	1.53	2.11	1,166
October 9	F. A. Murray	293	681	1.27	1.76	862
October 9	do	293	681	1.25	1.76	850

Daily gage height, in feet, of Etowah River near Rome, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.3	3.0	2.5	2.9	2.4	2.4	2.1	1.9	2.7	1.9	2.0
2	2.0	2.3	2.9	2.5	2.5	2.3	3.2	2.1	2.0	2.8	1.8	2.1
3	1.9	2.2	2.8	2.5	2.4	2.3	2.9	2.1	2.5	2.1	1.7	15.2
4	2.0	2.1	2.8	2.4	2.4	2.3	2.4	2.1	3.0	2.0	1.7	16.2
5	1.9	2.1	2.7	2.4	3.0	2.4	2.5	2.1	2.9	1.8	1.6	9.1
6	2.3	2.2	2.7	2.7	2.7	2.3	2.8	2.1	2.0	1.8	1.6	3.9
7	2.6	2.25	2.6	2.7	2.7	2.3	4.6	2.1	1.9	1.7	1.6	3.0
8	2.35	3.0	2.6	2.7	3.3	2.2	4.1	2.1	1.9	1.7	1.5	4.1
9	2.3	7.7	2.7	2.6	2.8	2.2	4.4	2.0	1.8	1.6	1.6	13.5
10	2.2	8.4	2.9	2.8	3.3	2.2	4.8	2.5	1.8	2.1	2.1	9.4
11	3.4	5.9	3.3	2.6	2.7	2.2	3.9	2.9	1.8	3.0	2.1	4.5
12	4.7	4.3	2.9	2.6	2.5	2.2	7.0	3.8	2.9	3.7	2.0	3.8
13	15.7	4.5	2.9	3.0	2.4	2.2	6.0	3.1	3.0	2.6	2.0	4.1
14	9.3	7.4	2.8	2.9	2.3	2.3	4.0	2.9	2.1	2.5	1.9	4.5
15	6.2	4.7	2.7	2.7	2.3	2.6	2.9	5.1	2.0	2.3	1.8	4.9
16	3.1	3.7	2.6	2.7	4.9	2.5	2.7	4.0	1.9	2.4	1.8	3.8
17	2.8	3.3	2.5	2.9	4.8	2.5	2.5	3.4	1.8	2.3	1.7	3.6
18	2.5	3.2	2.5	2.6	3.8	2.3	2.4	2.6	1.8	2.3	1.6	3.2
19	2.5	3.0	2.5	2.5	2.7	2.3	2.4	2.5	1.8	2.3	3.3	2.9
20	2.5	3.3	2.6	2.4	2.4	2.5	2.3	2.5	1.7	2.2	2.0	4.0
21	2.5	11.0	4.2	2.4	2.8	2.9	2.3	2.4	1.8	2.1	1.9	.....
22	2.5	10.0	4.5	2.5	3.5	2.5	2.4	2.3	1.7	2.0	1.8	.....
23	2.4	5.8	3.5	2.5	4.2	2.6	2.3	2.3	1.7	1.9	1.8	.....
24	2.35	4.5	3.0	2.4	9.0	3.8	2.1	3.0	1.7	1.9	1.9	4.2
25	2.35	3.8	2.9	2.4	4.8	2.6	2.1	3.0	1.7	2.0	2.1	3.8
26	2.2	3.5	2.8	2.4	3.6	2.3	2.2	2.6	1.6	2.2	2.0	3.5
27	2.0	3.2	2.7	2.4	3.6	2.3	2.1	2.3	1.6	2.3	2.4	3.2
28	2.0	3.1	2.7	2.4	3.2	2.8	2.1	2.3	1.6	2.4	2.3	3.2
29	2.0	.....	2.6	2.3	2.8	3.0	2.3	2.2	1.6	1.9	2.3	3.3
30	1.9	.....	2.5	.....	2.6	2.8	2.3	2.0	1.7	1.9	2.0	3.3
31	2.4	.....	2.5	.....	2.5	.....	2.2	1.9	.....	.....	.....	3.0

Station rating table for Etowah River near Rome, Ga., from August 17, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	360	1.70	735	2.20	1,260	2.70	1,890
1.30	425	1.80	830	2.30	1,380	2.80	2,030
1.40	495	1.90	930	2.40	1,500	2.90	2,175
1.50	570	2.00	1,035	2.50	1,625	3.00	2,320
1.60	650	2.10	1,145	2.60	1,755		

The above table is based on 10 discharge measurements made during 1904-1905. It is well defined.

NOTE.—This station was established for low-water records, and these only are reliable. The above rating table is applicable only to gage heights less than 3 feet. As it does not apply to the higher gage heights, no monthly estimates have been made.

AMICALOLA RIVER NEAR BALLGROUND, GA.

This station was established in 1905 for the purpose of making miscellaneous discharge measurements. It is located at Hollensheds Bridge, one-fourth of a mile above Heard's mill and about 15 miles northeast of Ballground, Ga.

Discharge measurements are made from the two-span covered bridge, about 150 feet in total length. The meter can be let down through the floor at the side of the bridge, but the current under the bridge is rough and not good for measurements. Some of the measurements were made about 40 feet below the bridge. The stream is important, and a good section is difficult to find, but it is probable that a better place than this will be found.

Gage heights are determined directly from the bench mark, which is a point on top of the downstream end of the wooden floor beam, 25 feet from the left-bank pier; elevation, 17.00 feet above the datum of the assumed gage.

Discharge data at this station are contained in Water-Supply Paper of the United States Geological Survey No. 27, page 45.

Discharge measurements of Amicalola Creek near Ballground, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 23	O. P. Hall	66	75	2.46	1.58	184
November 16 [a]	M. R. Hall	38	67	1.61	1.35	108
November 16 [a]	do	40	65	1.54	1.35	100

[a] Made at different section.

LONG SWAMP CREEK NEAR BALLGROUND, GA.

This station was established in 1905 for the purpose of making a series of miscellaneous discharge measurements. It is located at a wooden wagon bridge about 2 miles southeast from Ballground, Ga., and half a mile above the mouth of the creek which empties into Etowah River.

The current is swift at the station and above and below it. The bed is sandy, and the water is shallow.

Measurements are made from the downstream side of the wooden bridge of three spans The middle span, which includes all of the creek at all but high stages, is 50 feet long, and the two end spans are 35 feet each.

Gage heights are determined directly from the bench mark, which is a nail driven horizontally into the upstream side of a large sycamore tree on the right bank, about 100 feet below the bridge. Elevation, 8.00 feet above the datum of the assumed gage.

Discharge data at this station are contained in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 252.

Discharge measurements of Long Swamp Creek near Ballground, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 24	O. P. Hall	33	54	1.72	1.27	93
November 15	M. R. Hall	30	43	1.19	.84	50

COOSA RIVER AT RIVERSIDE, ALA.

This station was established September 25, 1896, by M. R. Hall. It is located at the Southern Railway bridge, Riverside, Ala., about 4 miles below Lock No. 4.

The channel is straight above the station for about 400 feet and below for about 3,000 feet. The current is swift, but broken by a ledge of rock 300 feet above the bridge. The channel is 614 feet between bridge abutments and is broken by four piers. The width at ordinary stages is about 575 feet. Both banks are high. The left bank is liable to overflow, but all water passes beneath the bridge. The bed of the stream is rocky and permanent and not very rough.

Discharge measurements are made from the railway bridge to which the gage is attached. The initial point for soundings is the water face of the abutment on the left bank, downstream side.

A standard chain gage is fastened to the downstream guard rail at a point 570 feet from the initial point for soundings. Length of the chain, 35.02 feet. The gage is read once a day by S. T. Waits, who is paid by the Alabama Geological Survey.

Bench marks were established as follows: (1) The capstone on the circular pier of the turn span; elevation, 26.80 feet. (2) A copper plug set in solid rock on the right bank, about 100 feet above the bridge; elevation, 11.95 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 99-100; WS 15, p 51; 27, p 48; 36, p 149; 48, p 164; 65, p 279; 83, pp 143-144; 98, p 146; 127, p 136.

Discharge: Ann 18, iv, p 100; 19, iv, p 247; WS 15, p 51; 27, p 57; 36, pp 149-150; 48, p 164; 65, p 279; 83, p 144; 98, p 147; 127, p 136.

Discharge, monthly: Ann 18, iv, p 101; 19, iv, p 248; 20, iv, p 187; 21, iv, p 150; 22, iv, p 200; WS 75, p 91; 83, p 145; 98, p 148; 127, p 138.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: WS 11, p 30; 15, p 52; 27, p 54; 36, p 150; 48, p 165; 65, p 280; 83, p 144; 98, p 147; 127, p 137.

Hydrographs: Ann 19, iv, p 249; 20, iv, p 187; 21, iv, p 150; 22, iv, p 200; WS 75, p 91.

Map: Ann 19, iv, p 246.

Rating tables: Ann 18, iv, p 101; 19, iv, p 248; WS 27, p 58; 39, p 445; 52, p 514; 65, p 322; 83, p 145; 98, p 148; 127, p 137.

Discharge measurements of Coosa River at Riverside, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 28	J. M. Giles	563	7,000	3.33	7.75	23,320
February 28	do	563	6,546	3.23	7.20	21,150
August 11	B. S. Drane	539	4,111	1.58	2.75	6,483
September 25	F. A. Murray	503	3,203	.83	1.14	2,643
November 29	W. E. Hall	514	3,451	.94	1.51	3,256

Daily gage height, in feet, of Coosa River at Riverside, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	3.3	5.6	3.0	3.6	3.9	3.8	2.05	1.75	1.0	1.5	1.5
2	4.0	3.2	4.9	3.0	4.0	3.4	3.7	2.1	1.6	1.2	1.45	1.5
3	3.8	3.0	4.4	2.9	4.3	3.0	3.6	1.9	1.6	1.5	1.4	3.6
4	3.4	2.7	4.0	2.85	4.1	2.7	3.2	1.65	1.8	1.85	1.4	6.1
5	3.0	3.5	3.8	2.8	3.8	2.55	3.0	1.5	2.0	1.8	1.3	8.3
6	2.25	5.4	3.7	2.9	3.7	2.45	2.85	1.5	2.05	1.65	1.2	9.7
7	2.6	7.2	3.5	3.0	3.8	2.4	2.8	1.5	2.1	1.6	1.2	9.7
8	2.95	9.2	3.5	3.1	4.0	2.3	2.75	1.45	1.8	1.5	1.2	6.1
9	3.1	13.1	3.5	3.4	4.0	2.25	3.1	1.45	1.4	1.45	1.2	5.0
10	3.5	14.8	3.8	3.6	3.6	2.15	3.7	1.65	1.4	1.55	1.25	6.3
11	4.0	14.5	4.5	3.6	3.5	2.1	3.0	2.7	1.3	1.75	1.4	8.9
12	6.3	13.8	4.9	3.5	3.4	2.05	4.5	3.1	1.25	2.4	1.4	10.7
13	11.5	13.1	4.9	3.2	3.4	2.0	5.2	3.5	1.2	2.6	1.3	9.0
14	12.8	12.9	4.6	3.4	3.0	2.0	6.3	4.1	1.4	3.0	1.3	7.6
15	13.0	12.3	4.2	3.4	2.65	2.0	6.2	5.1	1.9	3.1	1.35	5.8
16	12.5	10.2	3.8	3.4	3.9	2.1	6.0	4.7	2.25	2.8	1.3	6.4
17	11.1	9.0	3.5	3.2	6.7	2.25	5.0	5.1	2.05	2.2	1.25	6.8
18	8.3	7.6	3.3	3.0	6.9	2.45	3.4	5.2	1.8	2.2	1.2	6.8
19	5.2	7.0	3.2	3.0	6.9	2.45	2.5	5.0	1.25	2.1	1.2	6.1
20	4.6	7.9	3.1	3.0	5.6	2.5	2.4	4.7	1.2	2.1	1.2	5.3
21	4.0	10.0	5.5	2.7	4.6	2.65	2.3	3.7	1.15	1.8	1.2	6.8
22	3.6	12.4	5.9	2.75	4.4	2.8	2.1	3.0	1.15	1.5	1.15	8.6
23	3.2	12.6	6.4	2.75	4.1	2.8	2.05	2.5	1.15	1.45	1.2	10.4
24	3.0	12.6	6.7	2.65	6.2	3.1	2.0	2.3	1.15	1.4	1.4	10.9
25	2.9	12.6	6.4	2.6	8.4	3.2	1.9	2.05	1.15	1.3	1.5	8.6
26	2.7	12.0	4.8	2.6	9.9	3.3	1.8	2.0	1.1	1.3	1.35	8.0
27	2.6	9.6	4.2	2.7	10.5	3.0	1.75	2.0	1.0	1.3	1.3	6.9
28	2.6	7.2	3.8	2.75	8.8	2.8	1.7	2.0	1.0	1.3	1.25	6.2
29	3.0	.....	3.4	2.85	7.0	3.6	1.7	2.0	1.0	1.3	1.5	6.0
30	3.2	.....	3.2	3.4	5.7	3.9	1.7	2.0	1.0	1.45	1.5	5.8
31	3.2	.....	3.1	.....	4.5	.....	1.7	1.9	.....	1.5	.....	5.4

Station rating table for Coosa River at Riverside, Ala., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	1,150	1.60	3,430	2.90	6,835	4.40	11,920
.40	1,300	1.70	3,655	3.00	7,135	4.60	12,640
.50	1,450	1.80	3,890	3.10	7,440	4.80	13,360
.60	1,605	1.90	4,130	3.20	7,750	5.00	14,080
.70	1,760	2.00	4,380	3.30	8,070	5.20	14,800
.80	1,920	2.10	4,635	3.40	8,400	5.40	15,530
.90	2,085	2.20	4,895	3.50	8,740	5.60	16,270
1.00	2,255	2.30	5,160	3.60	9,080	5.80	17,010
1.10	2,435	2.40	5,425	3.70	9,430	6.00	17,750
1.20	2,620	2.50	5,695	3.80	9,780	6.20	18,490
1.30	2,810	2.60	5,970	3.90	10,130	6.40	19,230
1.40	3,010	2.70	6,250	4.00	10,480	6.60	19,970
1.50	3,215	2.80	6,540	4.20	11,200	6.80	20,710

The above table is based on discharge measurements made during 1904-5 and several older measurements. It is well defined between gage heights 0.4 foot and 4 feet. Above 4 feet the table is not so well defined, as the high-water measurements are more scattered. The high-water discharge is only approximate.

Estimated monthly discharge of Coosa River at Riverside, Ala., for 1905.

[Drainage area, 7,065 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	43,650	5,028	14,500	2.05	2.36
February	50,310	6,250	30,340	4.29	4.47
March	20,340	7,440	11,710	1.66	1.91
April	9,080	5,970	7,266	1.03	1.15
May	34,400	6,110	14,650	2.07	2.39
June	10,130	4,380	6,259	.886	.988
July	18,860	3,655	7,990	1.13	1.30
August	14,800	3,112	6,813	.964	1.11
September	5,028	2,255	3,203	.453	.505
October	7,440	2,255	3,921	.555	.640
November	3,215	2,528	2,838	.402	.448
December	35,880	3,215	21,330	3.02	3.48
The year	50,310	2,255	10,900	1.54	20.75

OOSTANAULA RIVER AT RESACA, GA.

This station was maintained by the United States Geological Survey from August 1, 1896, to April 30, 1899, and was reestablished at the beginning of the year 1905. It is located at the bridge of the Western and Atlantic Railway, in the town of Resaca, 800 feet south of the depot.

The channel is slightly curved, the same curve extending about 300 feet above and below the bridge. The current is moderate, becoming rather sluggish at low water. The right bank is rock at the edge of the water, and has a solid stone abutment and railroad embankment, which is above high-water level. The left bank is low, cultivated, and overflows during high water 480 feet to the end of the trestle. The bed of the stream is composed of rock near the right bank, but other parts appear to be sandy. To the left of the pier it is nearly filled up with logs and brush. There is one channel, broken by one pier at ordinary water.

Discharge measurements are made from the downstream side of the iron bridge. The bridge consists of three spans of 120 feet each, and 480 feet of trestle approach at the left bank. The left span of the bridge is entirely outside of the river, except at high water. Measurements are also made from a boat at the ferry about 200 feet above the bridge, where the section is somewhat better. The initial point for soundings is the end of the bridge at the right bank, downstream side.

Gage heights are observed from the United States Weather Bureau gage, which is a heavy timber attached vertically to the downstream side of the center pier of the bridge. Bench marks were established as follows: (1) The top of the downstream end of the second crossbeam from the right bank; elevation, 38.94 feet. (2) A cross mark on the top of the limestone bowlder on the north side of the river, about 130 feet from the end of the railroad bridge and 40 feet west of the railroad track; elevation, 34.23 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 98; WS 15, p 50; 27, p 48; 36, pp 146-147; 48, p 162; 65, p 277; 127, pp 138-139.
Discharge: Ann 18, iv, p 99; WS 15, p 50; 27, p 57; 36, p 147; 48, p 162.
Discharge, monthly: Ann 19, iv, p 245; 20, iv, pp 181-190; 21, iv, p 147; 22, iv, p 198; WS 75, p 90.
Discharge, yearly: Ann 20, iv, p 51.
Gage heights: WS 11, pp 28-30; 15, p 50; 27, p 52; 36, p 147; 48, p 163; 65, p 278.
Hydrographs: Ann 19, iv, p 246; 20, iv, p 190; 21, iv, p 148; 22, iv, p 198.
Rainfall and run-off relation: Ann 20, iv, p 181.
Rating tables: Ann 18, iv, p 99; 19, iv, p 245; WS 27, p 58; 39, p 445; 52, p 514; 65, p 322.

Discharge measurements of Oostanaula River at Resaca, Ga.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
1904.						
September 26 [a]	O. P. Hall	.....	676	0.40	0.95	273
November 25 [a]	.....do	.....	774	.55	1.57	427
December 21	M. R. Hall	.....	614	.97	1.79	598
1905.						
March 14	O. P. Hall	158	1,173	2.15	5.10	2,521
June 7	.....do	138	873	1.53	3.30	1,339
September 26	.....do	•177	828	.72	1.91	596
1906.						
January 2	M. R. Hall	156	1,079	2.01	4.60	2,167

[a] Made at different section.

Daily gage height, in feet, of Oostanaula River at Resaca, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	3.4	5.4	4.0	8.2	4.2	6.0	2.6	2.0	1.9	2.2	2.4
2	3.0	3.2	5.2	4.0	5.8	4.0	5.6	2.3	3.2	1.9	2.1	2.5
3	2.6	3.0	5.0	4.0	5.0	3.8	4.4	2.0	3.6	1.95	2.1	14.1
4	3.0	3.0	4.5	3.8	5.8	3.8	3.6	1.8	2.6	2.8	2.1	13.8
5	4.0	3.2	4.2	4.2	5.6	3.6	3.2	1.6	2.8	3.1	2.1	9.6
6	3.6	6.5	4.3	4.8	5.2	3.6	3.0	1.8	2.4	2.7	2.1	5.4
7	4.6	9.0	4.5	4.6	4.8	3.4	3.4	2.0	2.2	2.1	2.1	4.6
8	5.4	9.5	4.5	4.4	4.6	3.4	3.6	2.8	2.0	2.0	2.2	8.6
9	4.0	18.0	4.5	4.4	6.4	3.6	3.6	6.0	1.8	1.9	2.2	17.4
10	3.8	19.8	7.6	3.8	5.8	3.2	4.8	4.6	1.8	1.9	2.2	18.2
11	3.8	18.5	8.6	3.8	5.2	3.0	5.0	4.2	1.6	3.1	2.2	12.4
12	9.0	17.0	7.0	4.0	4.8	2.8	7.4	4.6	5.0	5.2	2.2	7.6
13	14.2	13.0	6.8	4.0	4.2	3.2	8.8	7.6	4.0	3.7	2.1	5.4
14	20.2	12.0	5.2	3.8	3.8	3.0	5.8	4.2	3.4	2.9	2.1	5.1
15	13.2	10.0	5.0	4.2	3.6	2.8	4.0	6.2	2.8	2.6	2.0	7.4
16	6.0	7.5	4.7	5.0	10.3	2.8	3.8	6.8	2.2	2.9	2.1	8.6
17	5.0	6.5	4.6	4.8	9.6	3.0	4.0	8.8	2.2	2.9	2.1	7.4
18	4.6	6.0	4.5	4.6	8.0	3.2	3.6	5.4	2.0	2.75	2.1	5.9
19	4.2	5.8	4.2	4.6	6.3	3.8	3.2	4.7	1.8	2.4	2.1	5.2
20	4.8	10.2	4.3	4.4	5.2	3.2	3.0	3.8	1.8	2.3	2.2	5.4
21	4.2	20.2	8.5	3.8	4.6	3.2	3.0	3.4	1.8	2.2	3.0	12.8
22	4.0	22.0	9.2	4.0	4.6	4.0	3.0	2.8	1.8	2.1	2.4	12.4
23	4.0	20.6	6.5	4.0	5.2	6.0	3.0	2.8	1.8	2.1	2.2	11.4
24	3.5	18.6	5.5	3.8	14.0	5.0	2.8	3.0	1.8	2.0	2.2	10.0
25	3.5	8.6	5.2	3.6	11.0	3.8	2.8	4.0	1.8	2.1	2.3	9.6
26	3.4	7.2	4.6	3.6	8.6	3.4	2.8	3.8	1.9	2.4	2.9	7.6
27	3.2	6.5	4.6	4.0	6.8	3.2	2.4	3.4	1.9	2.9	2.5	6.4
28	3.2	6.0	4.4	6.6	5.4	5.2	2.4	2.8	1.85	2.7	2.3	5.6
29	3.0	.....	4.2	6.2	5.0	4.2	4.0	2.6	1.85	2.4	2.3	6.1
30	3.2	.....	4.2	9.2	4.6	4.2	3.0	2.4	1.85	2.4	2.5	5.9
31	3.5	.....	4.0	.....	4.6	.....	2.8	2.2	.....	2.4	.....	5.2

Station rating table for Oostanaula River at Resaca, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	420	3.30	1,335	5.10	2,530	7.80	4,640
1.60	455	3.40	1,395	5.20	2,600	8.00	4,800
1.70	495	3.50	1,455	5.30	2,675	8.20	4,980
1.80	540	3.60	1,520	5.40	2,750	8.40	5,160
1.90	585	3.70	1,585	5.50	2,825	8.60	5,340
2.00	630	3.80	1,650	5.60	2,900	8.80	5,520
2.10	680	3.90	1,715	5.70	2,975	9.00	5,700
2.20	730	4.00	1,780	5.80	3,050	9.20	5,880
2.30	780	4.10	1,845	5.90	3,125	9.40	6,060
2.40	830	4.20	1,910	6.00	3,200	9.60	6,240
2.50	880	4.30	1,975	6.20	3,360	9.80	6,420
2.60	935	4.40	2,040	6.40	3,520	10.00	6,600
2.70	990	4.50	2,110	6.60	3,680	10.20	6,780
2.80	1,045	4.60	2,180	6.80	3,840	10.40	6,960
2.90	1,100	4.70	2,250	7.00	4,000	10.60	7,140
3.00	1,155	4.80	2,320	7.20	4,160	10.80	7,320
3.10	1,215	4.90	2,390	7.40	4,320	11.00	7,500
3.20	1,275	5.00	2,460	7.60	4,480		

The above table is based on six discharge measurements made during 1904-5 and one high-water measurement in 1906. It is well defined between gage heights 1.6 feet and 6 feet. Above 6 feet the table is uncertain, the high-water estimates being rough approximations. Above gage height 11 feet the rating curve is a tangent, the difference being 100 per tenth.

Estimated monthly discharge of Oostanaula River at Resaca, Ga., for 1905.

[Drainage area, 1,614 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	16,700	935	2,876	1.78	2.05
February	18,500	1,155	7,512	4.65	4.84
March	5,880	1,780	2,756	1.71	1.97
April	5,880	1,520	2,123	1.32	1.47
May	10,500	1,520	3,476	2.15	2.48
June	3,200	1,045	1,572	.974	1.09
July	5,520	830	1,793	1.11	1.28
August	5,520	455	1,735	1.07	1.23
September	2,460	455	818	.507	.566
October	2,600	585	922	.571	.658
November	1,155	630	752	.466	.520
December	14,700	830	5,409	3.35	3.86
The year	18,500	455	2,645	1.64	22.01

COOSAWATTEE RIVER AT CARTERS, GA.

This river is formed by the junction of Ellijay and Cartecay rivers at Ellijay, Ga., and flows in a southwesterly direction, joining the Conasauga to form the Oostanaula. Its drainage area is for the most part mountainous and covered with forest growth. The gaging station was established August 15, 1896, by M. R. Hall, at the iron highway bridge at Carters, Murray County, Ga. Carters is at the head of navigation, small boats running to Rome, Ga., and the Coosa River below. It is at the foot of the great shoals made by this stream in cutting through the Cohutta Mountains.

The channel is curved for 1,000 feet above and 500 feet below the station. The current is swift and broken. Both banks are high, but overflow at flood stages. The bed of the stream is of gravel and is not liable to change.

Discharge measurements are made from the single-span highway bridge and its approaches. The initial point for soundings is the land side of the pier on the right bank.

A standard chain gage is attached to the downstream side of the bridge in the third panel from the right bank; length of chain, 36.57 feet. The observer is R. P. Messer, who reads the gage once a day. Bench marks were established as follows: (1) The top of the cylindrical iron pier at the right bank, downstream side; elevation, 30.35 feet. (2) The top of a stone post set into the ground on the north side of the river, about 300 feet from the end of the iron bridge and on the west side of the road leading toward Carter's mill; elevation, 22.15 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 96-97; WS 15, p 49; 27, p 48; 36, pp 144-145; 48, p 161; 65, p 276; 83, p 151; 98, pp 156-157; 127, p 139.

Discharge: Ann 18, iv, p 97; WS 15, p 49; 27, p 57; 36, p 145; 48, p 161; 65, p 276; 83, p 151; 98, p 157; 127, p 140.

Discharge, monthly: Ann 19, iv, p 244; 20 iv, pp 180, 191; 21, iv, p 146; 22, iv, p 197; WS 75, p 89; 83, p 153; 98, p 159; 127, p 141.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: WS 11, p 27; 15, p 49; 27, p 52; 36, p 146; 48, p 162; 65, p 277; 83, p 152; 98, pp 157-158; 127, p 140.

Hydrographs: Ann 19, iv, p 244; 20, iv, p 192; 21 iv, p 147; 22, iv, p 197.

Rainfall and run-off relation: Ann 20, iv, p 181.

Rating tables: Ann 18, iv, p 98; 19, iv, p 243; WS 27, p 58; 39, p 445; 52, p 514; 65, p 322; 83, p 153; 98, p 158; 127, p 141.

Discharge measurements of Coosawattee River at Carters, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 18	O. P. Hall	112	372	2.28	2.10	848
March 28	do	112	389	2.36	2.21	917
June 6	do	112	326	2.13	1.77	694
September 28	do	108	212	1.70	1.02	361
December 30	do	111	384	2.45	2.39	942
December 30	M. R. Hall	111	384	2.48	2.39	951

Daily gage height, in feet, of Coosawattee River at Carters, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.4	3.0	2.4	2.5	2.0	1.9	1.5	1.4	1.0	1.1	1.1
2	1.8	1.5	3.0	2.2	2.0	2.0	1.8	1.5	4.2	1.0	1.1	2.0
3	1.8	1.4	2.8	2.1	2.0	1.95	1.8	1.4	3.5	1.1	1.1	18.2
4	1.8	1.4	2.7	2.0	1.9	1.8	1.8	1.4	2.0	1.0	1.0	9.0
5	1.7	1.4	2.6	2.0	1.9	1.8	1.9	1.35	1.6	1.0	1.0	4.0
6	1.7	1.5	2.3	2.3	2.3	1.75	2.0	1.35	1.4	.9	1.0	3.0
7	1.1	3.0	2.2	2.2	2.3	1.75	2.0	1.35	1.4	.9	1.0	3.0
8	1.2	9.5	2.2	2.2	2.2	1.7	1.9	1.6	1.35	.9	1.0	12.0
9	1.3	13.0	2.5	2.1	2.1	1.7	2.0	1.6	1.3	1.0	1.0	9.6
10	1.2	5.0	3.0	2.1	2.0	1.8	3.0	2.0	1.3	1.0	1.0	4.5
11	1.1	4.0	4.2	2.3	2.0	1.8	5.0	4.0	1.3	3.0	.9	2.5
12	14.5	4.0	3.2	2.5	1.9	1.7	5.5	3.0	6.0	1.8	.9	2.5
13	7.3	6.0	2.4	2.4	1.9	1.7	4.0	2.5	2.0	1.8	.9	2.5
14	4.2	4.0	2.3	2.3	1.85	1.7	2.0	2.0	1.5	1.8	.9	2.5
15	3.6	3.0	2.3	2.2	3.5	1.9	1.9	3.5	1.4	1.6	.9	2.5
16	3.1	3.0	2.2	2.0	5.5	1.8	1.9	3.0	1.3	1.4	.9	2.3
17	3.0	2.6	2.2	2.0	3.3	1.8	1.8	2.5	1.3	1.4	.9	2.2
18	2.8	2.6	2.1	1.95	2.5	1.7	1.8	2.4	1.2	1.4	.9	2.2
19	2.6	2.8	2.0	1.95	2.3	1.8	1.8	2.0	1.2	1.3	1.0	2.1
20	2.4	14.0	2.0	1.8	2.4	1.8	1.7	2.0	1.15	1.3	1.0	2.1
21	2.3	10.0	6.5	1.8	2.2	1.75	1.7	1.8	1.15	1.4	1.0	5.0
22	2.0	6.0	3.5	1.85	7.0	1.9	1.7	1.8	1.1	1.4	.9	4.0
23	1.8	4.0	3.0	1.9	4.0	1.9	1.8	1.7	1.05	1.3	.9	3.6
24	1.6	3.5	2.6	2.0	3.5	1.8	2.0	1.7	1.0	1.3	1.1	3.2
25	1.4	3.0	2.5	2.0	3.0	1.8	1.8	1.6	1.0	1.2	2.0	3.0
26	1.2	3.5	2.4	1.9	2.8	1.9	1.8	1.6	1.0	1.2	2.1	2.5
27	1.1	3.3	2.3	2.5	2.5	3.5	1.7	1.5	1.0	1.2	1.5	2.5
28	1.2	3.2	2.2	2.1	2.3	3.0	1.7	1.4	1.0	1.2	1.1	2.4
29	1.3	.....	2.2	2.0	2.3	2.0	1.6	1.4	1.0	1.3	1.1	2.4
30	1.3	.....	2.5	3.5	2.2	2.0	1.6	1.4	1.0	1.3	1.1	2.4
31	1.4	.....	2.5	.....	2.2	.....	1.5	1.4	.....	1.2	.....	2.4

Station rating table for Coosawattee River at Carters, Ga., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	325	1.90	740	2.80	1,170	3.70	1,680
1.00	360	2.00	785	2.90	1,220	3.80	1,740
1.10	400	2.10	830	3.00	1,275	3.90	1,805
1.20	440	2.20	875	3.10	1,330	4.00	1,870
1.30	480	2.30	920	3.20	1,385	4.20	2,000
1.40	520	2.40	970	3.30	1,440	4.40	2,130
1.50	560	2.50	1,020	3.40	1,500	4.60	2,270
1.60	605	2.60	1,070	3.50	1,560	4.80	2,410
1.70	650	2.70	1,120	3.60	1,620	5.00	2,550
1.80	695						

The above table is based on discharge measurements made during 1902-1905. It is well defined between gage heights 0.9 foot and 4.5 feet. The table has been extended beyond these limits. Above gage height 5 feet the rating curve is a tangent, the difference being 72 per tenth.

Estimated monthly discharge of Coosawattee River at Carters, Ga., for 1905.

[Drainage area, 531 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	9,300	400	1,140	2.15	2.48
February	9,030	520	2,264	4.26	4.44
March	3,630	785	1,144	2.15	2.48
April	1,560	695	858	1.62	1.81
May	3,990	718	1,147	2.16	2.49
June	1,560	650	752	1.42	1.58
July	2,910	560	887	1.67	1.92
August	1,870	500	759	1.43	1.65
September	3,270	360	652	1.23	1.37
October	1,275	325	490	.923	1.06
November	830	325	394	.742	.828
December	12,050	400	2,026	3.82	4.40
The year	12,050	325	1,043	1.96	26.51

CARTECAY RIVER NEAR CARTECAY, GA.

This station was established June 27, 1904, by M. R. Hall. It is located at the Cartecay Bridge on the public road 6 miles upstream from Ellijay, Ga., and 1½ miles northwest of Cartecay, Ga. Turkey Creek enters from the south side and Owltown Creek from the north side between this point and Ellijay. There is probably no considerable interference from dams above the station.

The channel is straight for about 500 feet above and below the station. The current is swift. Both banks are high, but are subject to overflow. The bed of the stream is composed of bowlders and is probably permanent, the water flowing in one channel.

Discharge measurements are made from the downstream side of the single 60-foot span wooden bridge. The bridge has an approach on the right bank of 24 feet and on the left bank of 26 feet. The initial point for soundings is the edge of the abutment on the right bank, downstream side.

The gage is a vertical 10-foot timber, fastened to the sill and downstream post of the trestle bent at the right bank. The gage is read once each day by S. A. Burrell, who is paid by the Georgia Geological Survey. The bench mark is the top of the downstream end of the first floor beam from the right bank, marked by nails and white paint; elevation, 16.50 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 142-143 .

Discharge measurements of Cartecay River near Cartecay, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 19	O. P. Hall	55	69	2.42	1.20	167
June 22	do	56	82	2.80	1.45	230
October 16	do	55	69	1.99	1.07	137

Daily gage height, in feet, of Cartecay River near Cartecay, Ga., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	0.95	1.45	1.3	1.7	1.5	1.6	1.1	1.15	1.3	0.9	1.1
2	.95	.95	1.4	1.3	1.7	1.4	1.5	1.0	1.15	1.2	1.3	1.3
3	.95	.9	1.4	1.25	1.6	1.35	1.4	1.0	1.2	1.2	1.2	4.6
4	.95	.85	1.3	1.2	1.5	1.2	1.4	.95	1.25	1.7	1.2	3.2
5	.9	.9	1.35	1.6	1.45	1.2	1.35	.9	1.2	1.4	1.1	2.0
6	1.55	1.1	1.4	1.5	1.4	1.15	1.2	.9	1.2	1.3	1.1	1.8
7	1.2	1.1	1.45	1.3	1.4	1.1	1.2	.95	1.15	1.2	1.1	1.4
8	1.1	2.1	1.3	1.25	1.9	1.15	1.2	1.6	1.1	1.1	.95	1.3
9	1.1	2.9	1.3	1.2	1.6	1.1	1.15	1.9	1.15	1.0	.95	2.5
10	1.2	2.8	1.65	1.1	1.5	1.1	1.15	1.8	1.15	1.0	.9	2.0
11	1.2	1.6	1.3	1.1	1.35	1.1	1.2	1.6	1.2	1.0	.9	1.7
12	9.7	1.4	1.3	1.7	1.3	1.0	4.3	1.5	1.9	1.1	.85	1.6
13	2.5	2.8	1.25	1.4	1.3	1.0	3.6	1.5	1.4	1.1	.85	1.6
14	1.7	1.6	1.2	1.3	1.25	1.1	2.7	1.6	1.3	1.1	.9	1.6
15	1.6	1.5	1.2	1.35	1.3	1.1	2.1	1.6	1.2	1.0	.9	1.5
16	1.4	1.5	1.2	1.3	2.1	1.6	1.9	3.6	1.2	.9	.9	1.5
17	1.45	1.4	1.25	1.3	1.6	1.4	1.3	2.9	1.15	.9	.9	1.4
18	1.35	1.4	1.25	1.3	1.4	1.2	1.3	2.1	1.15	.95	1.0	1.4
19	1.3	1.35	1.2	1.25	1.4	1.2	1.25	1.6	1.1	1.0	1.7	1.4
20	1.2	6.5	1.6	1.25	1.3	1.2	1.25	1.5	1.1	1.0	1.5	2.0
21	1.2	3.6	2.6	1.25	1.3	1.6	1.2	1.4	1.1	.9	1.3	1.7
22	1.15	2.2	1.8	1.2	2.6	2.3	1.2	1.35	.9	1.1	1.1	1.7
23	1.15	1.9	1.6	1.2	1.8	1.9	1.2	1.3	.9	1.1	1.1	1.6
24	1.2	1.7	1.5	1.25	1.7	1.6	1.1	1.3	.9	1.1	1.1	1.5
25	1.1	1.7	1.5	1.2	1.6	1.5	1.1	1.25	.95	1.3	1.5	1.4
26	1.1	1.65	1.5	1.25	1.6	1.5	1.1	1.2	.95	1.2	1.4	1.4
27	1.0	1.65	1.4	1.5	1.5	1.4	1.2	1.2	.9	1.1	1.3	1.3
28	1.0	1.5	1.3	1.3	1.4	1.4	1.2	1.2	1.0	1.1	1.2	1.3
29	1.0	.....	1.3	1.9	1.4	1.3	1.15	1.15	1.0	1.1	1.4	1.25
30	1.15	.....	1.6	1.8	1.35	1.9	1.15	1.1	1.6	.9	1.2	1.2
31	1.1	.....	1.4	.....	1.6	.....	1.15	1.1	.....	.9	.....	1.2

Station rating table for Cartecay River near Cartecay, Ga., from July 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	80	1.20	158	1.50	249	1.80	366
.90	95	1.30	185	1.60	286	1.90	411
1.00	113	1.40	215	1.70	326	2.00	456
1.10	134						

The above table is based on eight discharge measurements made during 1904–5. It is well defined between gage heights 0.8 foot and 1.5 feet. As the highest measurement is at 1.5 feet the table has not been extended beyond 2 feet. For that reason no monthly estimates have been made. The table as given covers the low-water period.

ELLIJAY RIVER AT ELLIJAY, GA.

This station was established June 28, 1904, by M. R. Hall, for the purpose of making a series of miscellaneous measurements. It is located at a wagon bridge about one-half mile east of Ellijay, Ga., and about the same distance above the junction of Ellijay and Cartecay rivers.

The channel is straight for about 500 feet above and below the station. The right bank is about 12 feet high and the left bank is about 10 feet high. Both banks are bordered by fields and are subject to overflow. There is one channel, broken by one wooden pier. The bed of the stream is conposed of rock, and the current ranges from very swift above the station to sluggish below.

Discharge measurements are made from the open wooden wagon bridge, having two 40-foot spans and 50-foot approaches on each bank. The initial point for soundings is the end of the bridge at the right bank, on the downstream side.

A gage staff, reading from 2 to 6 feet, is nailed to the downstream vertical post at the right bank, and a bench mark established for reference. Regular gage readings are not maintained. The bench mark is a small nail and white paint mark in the downstream vertical post at the right bank; elevation, 7.00 feet above datum of the assumed gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 127, p 143.
Discharge: 27, p 45; 36, p 145; 43, p 209; 98, p 293; 127, p 144.

Discharge measurements of Ellijay River at Ellijay, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 18	O. P. Hall	70	85	1.71	1.70	145
June 21	do	72	90	1.73	1.78	156
October 16	do	69	70	1.63	1.42	114

MOUNTAINTOWN CREEK NEAR ELLIJAY, GA.

This station was established May 10, 1904, by O. P. Hall for the purpose of making a series of miscellaneous discharge measurements. It is located at the covered bridge, known as Charles Bridge, about 4 miles west of Ellijay, Ga., and about the same distance above the mouth of the creek.

The channel is straight for about 500 feet above and 100 feet below the station. Both banks are high and not liable to overflow. The bed of the stream is rocky. The water is shallow and swift at the bridge, the better section being at the foot log below the bridge.

The bridge consists of a single span of 54 feet, with short trestle approaches at either end. Discharge measurements are made either from the bridge, where the meter is lowered through holes in the floor, or at a foot log half a mile below the bridge. The initial point for soundings is the end of the trestle approach at the right bank.

Gage heights are determined directly from the bench mark, which is a nail driven into the vertical post of the main bent under the right end of the bridge 6 feet above the top of the mud sill of the bent; elevation, 7.00 feet above the datum of the assumed gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, page 144.

Discharge measurements of Mountaintown Creek near Ellijay, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 19	O. P. Hall	58	44	3.45	1.05	152
October 17	do	53	36	2.55	.93	92

TALKING ROCK CREEK NEAR CARTERS, GA.

This station was established May 26, 1904, by O. P. Hall for the purpose of making a series of miscellaneous discharge measurements. Numerous measurements of the creek had previously been made in connection with measurements of the Coosawattee River station. It is located about 3 miles above the mouth of Talking Rock Creek and about the same distance east of Carters, Ga.

Both banks are high and will probably not overflow. There is one channel at all stages. The section is a good one.

Discharge measurements are made from a boat just above R. L. Hill's boat landing, or by wading at a shoal a short distance below.

Gage heights are determined directly from the bench mark, which is a nail in a large elm tree on the left bank at R. L. Hill's boat landing; elevation, 7.50 feet above the datum of the assumed gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 127, pp. 144-145.
Discharge: Ann 18, iv, p 97; 19, iv, p 252; WS 27, p 45; 36, p 145; 49, p 209; 127, p 145.

Discharge measurements of Talking Rock Creek near Carters, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 6	O. P. Hall	33	36	3.97	1.59	143
September 28	do	40	42	1.21	1.16	51

BIG CEDAR CREEK NEAR CAVESPRING, GA.

This station was established in 1905 for the purpose of making a series of miscellaneous discharge measurements. It is located at the wagon bridge about 3 miles north of Cavespring, Ga., 1 mile below the Southern Railway bridge and half a mile below the mouth of Little Cedar Creek.

The channel is straight for about 200 feet above and 300 feet below the bridge. The right bank is low and will overflow to the extent of the 100-foot wooden approach. The left bank is high and will not overflow. The bed is of sand and mud, and is therefore probably shifting. The current is sluggish at low stages.

Measurements are made from the single iron span 91 feet long. The initial point for soundings is the end of the bridge at the left bank, upstream.

Gage heights are determined directly from the bench mark, which is the top of the upstream end of the second floor beam from the right-bank end of the bridge; elevation, 20.00 feet above the datum of the assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, page 176.

Discharge measurement of Big Cedar Creek near Cavespring, Ga., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
July 25	W. E. Hall	48	211	0.55	2.70	117

CHOCCOLOCCO CREEK NEAR JENIFER, ALA.

The gage at this station was established August 20, 1902, by J. M. Giles. Measurements were first made by M. R. Hall in 1900. It is located at the Louisville and Nashville Railroad bridge, 1¼ miles north of Jenifer, Ala. There are small shoals both above and below the bridge.

The channel is straight for 1,500 feet above and below the station, and has a width of 100 feet at low water. The right bank overflows at a gage height of about 6 feet. The left bank is high and will not overflow except under the bridge. The bed is rocky and not likely to change.

Discharge measurements are made from the single-span bridge and its trestle approach on the right bank. The initial point for soundings is the end of the bridge on the left bank.

The gage consists of a vertical timber fastened to a birch tree 20 feet upstream from the bridge on the left bank. It reads from 0.3 foot to 10 feet. The observer is W. J. Tolbert, who is paid by the Alabama Geological Survey.

Bench marks were established as follows: (1) The top of the upstream end of the second floor beam from the left bank; elevation, 22.91. feet. (2) A copper plug in the upstream wing of the left abutment; elevation, 14.19 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, p 144; 127, p 145.
Discharge: 98, p 145; 127, p 146.
Discharge, monthly: 98, p 146; 127, p 148.
Gage heights: 98, p 145; 127, p 147.
Rating table: 98, p 145; 127, p 147.

Discharge measurements of Choccolocco Creek near Jenifer, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 31	J. M. Giles	103	225	1.72	2.80	387
January 31	do	103	225	1.77	2.78	399
May 16	M. R. Hall	111	317	2.48	3.72	785
May 16	do	111	316	2.48	3.74	783
September 22	F. A. Murray	88	120	.73	1.76	88
December 18	W. E. Hall	103	224	1.83	2.83	409

Daily gage height, in feet, of Choccolocco Creek near Jenifer, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.6	2.7	2.5	2.2	2.5	2.45	2.0	1.9	1.9	1.8	1.9
2	1.95	2.5	2.65	2.4	2.2	2.4	2.8	2.0	1.9	1.95	1.8	1.85
3	1.95	2.4	2.6	2.4	2.3	2.4	2.6	2.0	2.0	1.9	1.8	4.7
4	1.9	2.4	2.6	2.4	2.2	2.35	2.3	1.9	1.9	1.85	1.6	5.0
5	1.9	2.4	2.5	2.4	2.2	2.3	2.2	1.9	1.9	1.8	1.8	4.0
6	1.9	3.5	2.5	2.5	2.2	2.2	2.1	1.9	1.85	1.75	1.8	2.7
7	2.0	3.6	2.5	2.55	2.2	2.2	2.3	1.9	1.9	1.75	1.7	2.5
8	2.1	4.2	2.4	2.5	2.25	2.2	2.3	1.9	1.9	1.8	1.8	2.4
9	2.0	6.8	2.6	2.4	2.2	2.2	2.25	2.1	1.9	1.75	1.7	3.6
10	2.0	7.5	3.4	2.4	2.2	2.15	2.2	2.2	1.9	1.8	1.75	4.6
11	2.0	5.7	3.1	2.4	2.2	2.1	2.9	2.3	1.85	2.0	1.8	4.0
12	5.7	4.2	2.8	2.6	2.1	2.1	3.5	2.1	2.4	2.1	1.9	3.0
13	7.5	5.1	2.75	2.55	2.1	2.1	3.2	3.3	2.0	2.0	1.9	2.7
14	7.1	5.0	2.6	2.45	2.1	2.1	2.3	2.6	1.95	1.8	1.85	2.6
15	3.9	4.3	2.6	2.4	2.1	2.1	2.3	2.5	1.9	1.8	1.8	2.6
16	3.1	3.6	2.5	2.4	3.6	2.5	2.3	2.6	1.85	1.8	1.75	3.1
17	2.8	3.4	2.45	2.4	2.7	2.3	2.2	2.9	1.85	1.9	1.75	3.0
18	2.7	3.2	2.4	2.35	3.0	2.2	2.1	2.4	1.8	1.9	1.75	2.8
19	2.6	3.2	2.4	2.3	2.6	2.2	2.1	2.3	1.8	1.9	1.8	2.6
20	2.6	3.3	2.8	2.3	2.45	2.65	2.3	2.2	1.8	1.85	1.8	2.8
21	2.5	4.3	5.1	2.3	2.6	2.6	2.1	2.2	1.8	1.8	1.8	4.6
22	2.4	4.6	5.4	2.3	2.55	2.3	2.1	2.1	1.8	1.8	1.8	4.8
23	2.4	3.8	4.0	2.3	3.0	2.3	2.1	2.0	1.8	1.8	1.8	5.0
24	2.3	3.5	2.35	2.3	3.1	2.35	2.1	2.1	1.8	1.8	1.8	4.1
25	2.5	3.2	2.1	2.2	3.5	2.7	2.0	2.0	1.75	1.8	1.8	3.8
26	2.2	3.1	2.9	2.2	3.6	2.35	2.0	2.0	1.8	1.8	1.85	3.3
27	2.2	2.9	2.8	2.25	3.5	2.35	2.0	2.0	1.7	1.7	1.9	3.1
28	2.1	2.8	2.6	2.2	3.3	2.3	2.0	2.0	1.65	1.8	1.9	2.9
29	2.1	.....	2.6	2.2	3.0	3.5	2.0	1.9	1.7	1.8	1.9	3.2
30	2.5	.....	2.6	2.2	2.7	2.5	2.2	1.9	1.8	1.8	1.9	3.2
31	2.7	.....	2.5	.....	2.6	.....	2.1	1.9	.....	1.8	.....	3.0

Station rating table for Choccolocco Creek near Jenifer, Ala., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	68	1.90	108	2.20	170	2.50	272
1.70	80	2.00	124	2.30	202	2.60	310
1.80	94	2.10	144	2.40	236	2.70	350

The above table is based on discharge measurements made during 1903–1 05. It is well defined between gage heights 1.7 feet and 3.8 feet. Above gage height 2.7 feet the rating curve is a tangent, the difference being 42 per tenth.

Estimated monthly discharge of Choccolocco Creek near Jenifer, Ala., for 1905.

[Drainage area, 272 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,366	108	410	1.50	1.73
February	2,366	236	824	3.03	3.16
March	1,484	144	411	1.51	1.74
April	310	170	226	.831	.927
May	770	144	338	1.24	1.43
June	686	144	225	.827	.923
July	686	124	216	.794	.915
August	602	108	175	.643	.741
September	236	74	105	.386	.431
October	144	80	99.8	.367	.423
November	108	68	94.5	.347	.387
December	1,316	101	625	2.30	2.65
The year	2,366	68	312	1.15	15.46

TALLAPOOSA RIVER AT STURDEVANT, ALA.

This station was established July 19, 1900, by M. R. Hall. It is located at the Columbus and Western Railroad bridge, one-fourth mile west of Sturdevant. The station, being above the dams at Tallassee, is intended to replace the Milstead station. A map and profile of Tallapoosa River is published in the Twenty-second Annual Report of the United States Geological Survey, Part IV.

The channel is slightly curved directly above the bridge and for about one-half mile below. The current is swift and much broken by shoals below the bridge, but is sluggish at low stages at and near the station. Both banks are high, the right overflowing for about 150 feet and the left for about 200 feet. The bed is of rock and gravel and is probably permanent.

At ordinary stages discharge measurements are made from a footway supported by the bracing of the lower chord of the bridge. At low stages measurements are made from a boat of by wading about 2,000 feet upstream or about 500 feet below the bridge. The initial point for soundings is the end of the iron bridge on the east or left bank, downstream side.

The original gage was a staff in two sections. June 10, 1905, a standard chain gage was fastened to the lower chord on the downstream side of the second span of the bridge; length of the chain, 39.49 feet. The bottom of the gage box is 37.49 feet above the datum of the gage. Bench marks were established as follows: (1) A wire nail driven into the southwest corner of the second pier on the east bank; elevation, 14.20 feet. (2) A copper plug set in solid rock in the bed of the river about 80 feet below the bridge, at a point 400 feet from the end of the bridge at the left bank, the rock projecting above the water at ordinary stages; elevation, 4.89 feet. (3) A white-paint mark on the downstream end of the lower crossbeam at a point 278 feet from the initial point for soundings; elevation, 37.65 feet. (4) A cross mark cut on the left side of the second stone pier from the left bank, 7 feet from the downstream corner and 6 feet above the ground; elevation, 15.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 167; 65, p 272; 83, p 137; 98, pp 136-137; 127, p 153.
Discharge: 48, p 167; 65, p 272; 83, p 137; 98, p 137; 127, p 154.

Discharge, monthly: 83, pp 138-139; 98, p 139; 127, p 156.
Gage heights: 48, p 167; 65, p 272; 83, pp 137-138; 98, pp 137-138; 127, p 155.
Rating tables: 83, p 138; 98, p 138; 127, p 155.

Discharge measurements of Tallapoosa River at Sturdevant, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 30	J. M. Giles	364	2,461	0.81	2.28	2,001
February 9	do	428	5,556	3.81	9.75	21,150
February 9	do	428	5,607	3.80	9.80	21,290
February 10	do	420	4,929	3.16	8.15	15,570
February 10	do	422	5,103	3.27	8.60	16,670
February 11	do	406	4,254	2.64	6.60	11,240
May 17	M. R. Hall	394	2,947	1.43	3.88	4,212
June 10	W. E. Hall	290	2,008	.46	1.39	932
September 23 [a]	F. A. Murray	175	739	.52	.34	385
October 26	W. E. Hall	342	2,300	.80	2.33	1,838

[a] Measured from a boat one-fourth mile above bridge.

Daily gage height, in feet, of Tallapoosa River at Sturdevant, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.7	3.2	2.7	2.75	2.3	2.9	2.5	2.3	0.4	1.1	1.6
2	1.9	2.6	3.1	2.7	2.55	2.2	2.2	2.0	1.4	1.5	1.1	1.4
3	1.8	2.4	3.0	2.7	2.7	2.0	1.9	1.6	1.7	1.4	1.0	8.4
4	1.75	2.35	2.9	2.6	2.9	1.85	1.6	1.2	2.2	1.3	1.0	10.3
5	1.6	2.5	2.9	2.7	3.0	1.8	1.45	1.1	1.9	1.9	1.0	7.4
6	1.7	3.7	2.9	2.8	2.7	1.7	1.3	.9	1.49	1.3	.95	5.5
7	2.2	4.0	2.8	2.8	2.4	1.65	1.2	.8	1.2	1.1	.95	3.8
8	1.9	5.4	2.8	3.1	3.0	1.6	1.3	.7	1.1	.8	.9	3.4
9	1.7	9.5	3.3	3.3	3.5	1.5	1.8	1.6	.9	.75	1.0	8.4
10	2.1	8.8	3.8	3.1	3.1	1.4	2.0	1.5	.8	.9	1.2	8.2
11	1.9	6.6	3.9	3.6	2.7	1.4	2.45	3.0	.7	1.5	1.8	6.8
12	9.0	6.0	3.6	3.4	2.5	1.35	3.9	4.4	1.0	1.7	2.0	5.8
13	15.8	8.6	3.5	3.9	2.3	1.3	4.1	6.7	.9	1.4	2.0	3.6
14	10.5	7.7	3.4	3.8	2.1	1.8	3.2	4.0	.75	1.25	1.8	3.2
15	8.0	5.8	3.3	3.4	2.0	2.25	2.6	2.9	1.0	1.2	1.6	3.1
16	5.1	4.9	3.1	3.4	3.6	1.85	2.1	3.4	.9	1.4	1.45	3.3
17	3.8	4.3	3.0	3.2	3.9	1.7	1.65	7.5	.7	1.65	1.3	3.4
18	3.1	4.0	2.9	3.0	3.6	2.4	1.4	4.6	.6	1.6	1.2	3.3
19	3.0	3.9	2.8	2.85	2.9	2.4	1.3	3.7	.6	1.55	1.1	3.5
20	3.2	4.2	3.3	2.7	2.6	2.2	1.5	3.1	.5	1.4	1.1	4.6
21	3.0	4.8	6.4	2.65	2.6	2.3	1.2	2.6	.5	1.15	1.1	8.4
22	2.8	5.8	6.2	2.85	3.2	2.0	1.25	2.9	.45	1.0	1.0	7.7
23	2.7	4.9	5.1	2.8	3.6	1.8	1.1	2.4	.4	.9	1.1	6.1
24	2.5	4.3	4.0	2.8	3.4	2.2	1.0	2.2	.3	.8	1.1	5.4
25	2.4	4.0	3.6	2.65	3.6	1.8	1.95	2.0	.25	.9	1.2	4.6
26	2.2	3.7	3.4	2.55	4.0	2.0	1.7	2.2	.2	2.4	1.2	4.0
27	2.1	3.4	3.2	2.55	3.5	2.2	1.4	2.1	.1	1.8	1.3	3.6
28	2.1	3.3	3.1	2.5	3.4	3.0	1.35	2.3	.1	1.7	1.25	3.4
29	2.0	.....	3.0	2.6	2.9	2.5	2.65	1.8	.1	1.6	1.4	3.6
30	2.2	.....	2.9	3.0	2.75	2.3	2.2	1.7	.2	1.4	1.85	3.5
31	2.5	.....	2.8	.....	2.4	.....	2.1	2.2	.....	1.2	.....	3.3

Station rating table for Tallapoosa River at Sturdevant, Ala., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.10	296	1.50	1,020	2.90	2,580	4.60	5,770
.20	334	1.60	1,100	3.00	2,730	4.80	6,250
.30	374	1.70	1,180	3.10	2,880	5.00	6,760
.40	416	1.80	1,270	3.20	3,030	5.20	7,280
.50	460	1.90	1,360	3.30	3,190	5.40	7,800
.60	506	2.00	1,460	3.40	3,350	5.60	8,330
.70	554	2.10	1,560	3.50	3,520	5.80	8,880
.80	604	2.20	1,670	3.60	3,690	6.00	9,440
.90	656	2.30	1,790	3.70	3,870	6.20	10,000
1.00	710	2.40	1,910	3.80	4,060	6.40	10,560
1.10	766	2.50	2,040	3.90	4,250	6.60	11,140
1.20	824	2.60	2,170	4.00	4,450	6.80	11,740
1.30	885	2.70	2,300	4.20	4,870	7.00	12,350
1.40	950	2.80	2,440	4.40	5,310		

The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 0.4 foot and 10 feet. Above gage height 7 feet the rating curve is a tangent, the difference being 320 per tenth.

Estimated monthly discharge of Tallapoosa River at Sturdevant, Ala., for 1905.

[Drainage area, 2,500 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	40,510	1,100	4,977	1.99	2.29
February	20,350	1,850	6,897	2.76	2.87
March	10,560	2.440	3,647	1.46	1.68
April	4,250	2,040	2,694	1.08	1.20
May	4,450	1,460	2,744	1.10	1.27
June	2,730	885	1,459	.584	.652
July	4,660	710	1,540	.616	.710
August	13,950	554	2,754	1.10	1.27
September	1,790	296	677	.271	.302
October	1,910	416	929	.372	.429
November	1,460	656	889	.356	.397
December	22,910	950	7,411	2.96	3.41
The year	40,510	296	3,052	1.22	16.48

CAHABA RIVER AT CENTERVILLE, ALA.

This station was established August 7, 1901, and is situated at the iron highway bridge one-fourth mile west of Centerville, Ala., one-half mile above the Mobile and Ohio Railroad bridge.

The channel is straight for 1,500 feet above the station and one-half mile below. The current is swift. The right bank overflows at extreme high water. The left bank overflows only under the approach to the bridge. The bed is nearly all rock, and there is but one channel, broken by the piers of the bridge.

Discharge measurements are made from the single-span highway bridge supported by

tubular iron piers. The initial point for soundings is the end of the bridge on the left bank, downstream side.

The original chain gage was fastened to the timber railing along the downstream side of the bridge, about 100 feet from the initial point for soundings. July 12, 1905, a standard chain gage was fastened to the downstream side of the fourth panel from the left-bank end of the bridge; length of the chain, 48.87 feet. The bottom of the gage box at the pulley is 46.87 feet above the datum of the gage. The datum is the same as that of the original gage. The observer is W. C. Edwards, who is paid by the Alabama Geological Survey. Bench marks were established as follows: (1) The downstream end of the fourth floor beam from the right bank; elevation, 42.85 feet. (2) A chisel cut on the downstream side of the downstream pier at the left bank; elevation, 10.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 283; 83, p 129; 98, p 129; 127, pp 157-158.
Discharge: 65, p 283; 83, p 129; 98, p 129; 127, p 158.
Discharge, monthly: 83, p 130; 98, p 131; 127, p 160.
Gage heights: 65, p 283; 83, p 129; 98, p 130; 127, p 159.
Rating tables: 83, p 130; 98, p 130; 127, p 159.

Discharge measurements of Cahaba River at Centerville, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 20	J. M. Giles	182	1,642	2.36	8.85	3,882
February 21	do	202	2,274	2.29	12.15	5,204
February 21	do	202	2,352	2.14	12.25	5,082
February 24	do	173	1,399	2.03	7.36	2,842
February 25	do	172	1,297	1.93	6.77	2,504
February 25	do	172	1,274	1.91	6.70	2,431
June 27	W. E. Hall	120	289	1.38	1.90	398
June 28	do	120	281	1.38	1.82	388
June 28	do	120	281	1.40	1.82	393
July 11	do	155	701	1.84	4.44	1,287

Daily gage height, in feet, of Cahaba River at Centerville, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	6.7	4.4	3.4	6.2	4.0	4.2	2.4	1.8	1.3	1.1	1.3
2	2.1	5.4	4.3	3.3	5.3	3.8	3.9	2.1	1.6	1.2	1.0	1.4
3	2.0	4.6	4.0	3.1	4.7	3.2	3.5	1.8	1.8	1.2	1.2	11.9
4	1.9	4.8	3.7	3.0	4.2	2.5	2.6	1.6	1.9	1.2	1.1	7.1
5	1.8	7.0	3.6	4.4	3.7	2.4	2.3	1.5	2.3	1.2	1.2	4.0
6	1.9	16.5	3.4	4.4	3.4	2.3	2.0	1.3	2.2	1.3	1.3	2.6
7	2.0	15.9	3.3	4.0	4.0	2.2	2.5	1.3	1.8	1.2	1.3	2.6
8	2.0	17.3	3.2	4.8	7.7	2.0	2.1	1.3	1.7	1.3	1.2	2.5
9	2.0	25.9	3.4	11.5	9.4	2.0	2.0	1.4	1.6	1.2	1.2	2.5
10	2.0	23.9	4.6	6.7	5.3	1.9	2.3	1.6	1.4	2.0	1.3	2.4
11	1.9	19.3	4.0	5.0	4.0	1.8	4.5	2.4	1.4	2.6	1.7	2.2
12	25.5	13.6	3.5	5.0	3.4	1.8	5.8	3.1	1.8	2.1	1.6	2.1
13	24.2	22.8	3.3	4.3	3.1	1.8	4.6	2.8	1.5	1.7	1.3	2.1
14	21.3	19.5	3.0	3.9	2.8	1.8	3.0	3.1	1.5	1.6	1.4	2.1
15	11.0	15.6	2.9	4.1	2.9	3.2	2.5	3.0	1.4	1.6	1.5	3.1
16	7.0	11.2	2.8	5.2	9.5	2.0	2.1	1.9	1.3	1.6	1.4	3.9
17	5.5	9.1	2.8	4.3	7.2	2.5	1.9	3.7	1.3	1.7	1.3	3.8
18	4.7	7.3	2.7	3.8	5.4	1.9	1.8	4.6	1.3	1.5	1.2	3.5
19	4.3	6.5	2.6	3.5	4.4	2.0	1.6	2.8	1.3	1.5	1.2	3.2
20	4.2	7.5	6.6	3.3	3.6	1.9	1.6	4.8	1.7	1.4	1.4	3.5
21	3.9	12.2	20.4	3.2	5.8	2.0	1.5	4.6	1.5	1.3	1.3	6.5
22	3.5	12.5	14.7	4.2	10.3	1.8	1.6	3.5	1.3	1.2	1.3	7.5
23	3.2	9.6	11.5	3.7	12.0	1.7	3.3	3.4	1.2	1.2	1.3	7.9
24	3.0	7.5	8.3	3.3	12.2	1.8	2.5	3.0	1.1	1.1	1.3	10.5
25	2.8	6.7	6.7	3.1	8.8	1.7	3.3	3.1	1.1	1.3	1.4	8.5
26	2.6	5.9	5.4	5.1	6.6	1.6	2.7	3.7	1.2	1.9	1.4	6.4
27	2.4	5.3	4.7	5.5	5.7	2.0	2.3	4.1	1.2	1.6	1.3	4.8
28	2.3	4.6	4.5	6.7	5.2	1.8	1.8	3.0	1.2	1.4	1.3	4.5
29	2.6	.....	4.3	6.7	4.4	2.2	1.7	2.4	1.2	1.3	1.4	6.3
30	6.5	.....	4.0	6.5	3.8	4.4	1.8	2.1	1.3	1.2	1.5	5.4
31	8.5	.....	3.7	.....	3.8	.....	2.5	1.9	.....	1.2	.....	4.6

Station rating table for Cahaba River at Centerville, Ala., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	160	2.30	519	3.60	957	4.90	1,491
1.10	185	2.40	549	3.70	995	5.00	1,540
1.20	211	2.50	580	3.80	1,033	5.20	1,640
1.30	237	2.60	611	3.90	1,071	5.40	1,740
1.40	263	2.70	643	4.00	1,110	5.60	1,842
1.50	290	2.80	675	4.10	1,149	5.80	1,946
1.60	317	2.90	707	4.20	1,189	6.00	2,050
1.70	345	3.00	740	4.30	1,229	6.20	2,158
1.80	373	3.10	775	4.40	1,269	6.40	2,266
1.90	401	3.20	811	4.50	1,310	6.60	2,374
2.00	430	3.30	847	4.60	1,352	6.80	2,482
2.10	459	3.40	883	4.70	1,397	7.00	2,590
2.20	489	3.50	920	4.80	1,442		

The above table is based on discharge measurements made during 1903–1905. It is well defined between gage heights 1 foot and 7 feet. Above gage height 7 feet the rating curve is a tanget, the difference being 55 per tenth.

Estimated monthly discharge of Cahaba River at Centerville, Ala., for 1905.

[Drainage area, 1,040 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	12,760	373	2,102	2.02	2.33
February	12,980	1,352	5,129	4.93	5.13
March	9,960	611	1,774	1.71	1.97
April	5,065	740	1,440	1.38	1.54
May	5,450	675	2,024	1.95	2.25
June	1,269	317	521	.501	.559
July	1,946	290	653	.628	.724
August	1,442	237	665	.639	.737
September	519	185	291	.280	.312
October	611	185	280	.269	.310
November	345	160	241	.232	.259
December	5,285	237	1,496	1.44	1.66
The year	12,980	160	1,385	1.33	17.78

TOMBIGBEE RIVER AT COLUMBUS, MISS.

This station is located at the county highway bridge at the south end of Main street in the city of Columbus, Miss.

The channel is slightly curved for 500 feet above and 1,000 feet below the station. The current is sluggish at low stages and very swift above a gage height of 12 feet. The right bank is high and seldom overflows. The left bank overflows only under the bridge approach at a gage height of 18 to 22 feet. The bed of the stream is of soft limestone or chalk. The width of the river at low water is 160 feet. The maximum recorded height of the river was on April 8, 1892, when the gage registered 42 feet. The lowest recorded height was on October 26, 1893, when the gage reading was — 3.9 feet.

Discharge measurements are made from the bridge. The initial point for soundings is the end of the iron bridge on the right bank, downstream side.

Prior to 1905 the records of the United States Weather Bureau gage were used. This gage is located about 1,000 feet below the bridge and 1 mile from the Southern Railway station. It is a vertical timber set in a cross cut in the nearly vertical bluff on the left bank. July 13, 1905, a standard chain gage was attached to the upstream lower chord, 30 feet to the right of the center of the draw span of the bridge; length of chain, 48.01 feet. The bottom of the gage box is 41.01 feet above gage datum. The new gage was set to accord with bench mark No. 1 on the bridge, the elevation of which is 39.85 feet above datum. This bench mark was established several years ago by measuring down to the water surface and reading the height of the water on the vertical gage at the same time. It has been used for determining the gage height for most of the discharge measurements, as the position of the vertical gage makes it difficult to read accurately at low stages. The new gage will therefore read with the vertical gage at low and ordinary stages. The gage is read by C. R. Shackelford, the bridge watchman. Bench marks were established as follows: (1) The top of the downstream girder at a point 250 feet from the initial point for soundings; elevation, 39.85 feet. This point is on the movable portion of the drawbridge and may vary in elevation. (2) A copper plug in a tree at the southeast corner of First street and Second avenue; elevation, 18.04 feet. (3) The top of the rail at the depot of the Southern Railway; elevation, 55.20 feet. Elevations refer to the datum of the gage. Bench mark No. 3 is 191 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of United States Geological Survey:

Description: 48, pp 174-175; 65, p 285; 83, p 161; 98, pp 166-167; 127, pp 160-161.
Discharge: 65, p 285; 83, p 162; 98, p 167; 127, p 161.
Discharge, monthly: 75, p 97; 83, p 163; 98, p 169; 127, p 163.
Gage heights: 48, p 175; 65, p 285; 83, p 162; 98, pp 167-168; 127, p 162.
Rating tables: 65, p 323; 83, p 163; 98, p 168; 127, p 162.

Discharge measurements of Tombigbee River at Columbus, Miss., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 15	J. M. Giles	409	7,440	4.28	20.32	31,880
February 15	do	389	7,295	4.23	20.05	30,890
February 18	do	305	5,172	3.76	13.70	19,430
June 22	W. E. Hall	115	1,210	1.49	− .82	1,808
July 13	do	182	1,522	2.23	1.11	3,403
November 23	do	101	1,068	.92	− 2.00	987

Daily gage height, in feet, of Tombigbee River at Columbus, Miss., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		−0.0	−0.9	−2.7	−1.9	−2.2
2		−1.1	−2.0	−2.9	−2.2	−2.0
3		−1.45	−1.9	− .9	−2.3	−1.3
4		−1.45	−2.1	− .2	−2.4	− .4
5		−1.5	−1.8	−1.0	−2.5	− .0
6		−1.95	−2.0	−1.2	−2.4	.4
7		−2.4	−2.2	−1.0	−2.4	.4
8		−2.25	−2.05	−1.4	−2.3	.0
9		−1.8	−2.0	−2.1	−2.4	− .4
10		−1.55	−2.9	−1.9	−2.1	− .9
11		4.9	−2.7	−1.4	.7	−1.1
12		5.7	−2.1	− .9	.7	−1.2
13	1.1	4.7	−2.0	−1.0	.8	−1.1
14	.95	4.6	−1.6	− .7	.9	−1.0
15	− .3	3.3	−1.7	− .7	.6	4.8
16	−1.25	3.1	−1.7	1.9	− .2	6.8
17	−1.9	3.3	−1.9	1.3	− .9	6.0
18	−2.2	3.2	−2.3	.6	−1.4	5.9
19	−2.5	2.55	−2.6	.2	−1.6	5.9
20	−2.65	1.3	−2.4	− .6	−1.7	5.9
21	−2.8	3.5	−1.5	−1.6	−1.9	7.1
22	−2.95	.7	−2.4	−2.1	−2.0	7.0
23	−3.0	.4	−2.6	−2.3	−2.0	6.4
24	−2.95	− .05	−2.7	−2.4	−2.0	7.1
25	−2.05	− .25	−2.6	−2.5	−2.0	6.8
26	−2.3	1.75	−2.6	−1.6	−2.1	6.5
27	−2.4	2.2	−2.9	−1.8	−2.2	6.0
28	−2.15	1.9	−3.0	−1.9	−2.3	5.0
29	−2.05	.8	−3.1	−1.4	−2.3	4.8
30	−2.55	− .7	−3.2	−1.6	−2.2	4.1
31	−2.15	−1.5		−1:8		3.5

Station-rating table for Tombigbee River at Columbus, Miss., from July 13 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−3.20	360	−1.40	1,375	0.40	2,800	3.40	5,830
−3.10	405	−1.30	1,440	.50	2,890	3.60	6,060
−3.00	450	−1.20	1,510	.60	2,980	3.80	6,300
−2.90	500	−1.10	1,580	.70	3,070	4.00	6,540
−2.80	550	−1.00	1,650	.80	3,160	4.20	6,780
−2.70	605	− .90	1,725	.90	3,250	4.40	7,020
−2.60	660	− .80	1,800	1.00	3,340	4.60	7,270
−2.50	715	− .70	1,880	1.20	3,540	4.80	7,530
−2.40	770	− .60	1,960	1.40	3,740	5.00	7,790
−2.30	825	− .50	2,040	1.60	3,940	5.20	8,050
−2.20	880	− .40	2,120	1.80	4,140	5.40	8,310
−2.10	940	− .30	2,200	2.00	4,340	5.60	8,570
−2.00	1,000	− .20	2,280	2.20	4,540	5.80	8,830
−1.90	1,060	− .10	2,360	2.40	4,740	6.00	9,090
−1.80	1,120	.00	2,440	2.60	4,950	6.50	9,740
−1.70	1,180	.10	2,530	2.80	5,170	7.00	10,440
−1.60	1,245	.20	2,620	3.00	5,390	7.50	11,140
−1.50	1,310	.30	2,710	3.20	5,610		

The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights −2 feet and +2 feet. The table has been extended above 2 feet, being based on the general direction of the 1904 curve.

Estimated monthly discharge of Tombigbee River at Columbus, Miss., for 1905.

[Drainage area, 4,440 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
July 13-31	3,440	450	1,142	0.257	0.182
August	8,700	770	3,576	.805	.928
September	1,725	360	868	.195	.218
October	4,240	500	1,578	.355	.409
November	3,250	715	1,369	.308	.344
December	10,580	880	5,738	1.29	1.49

TOMBIGBEE RIVER AT EPES, ALA.

This station was established November 29, 1904, by M. R. Hall. It is located at the bridge of the Alabama Great Southern Railway, one-half mile from Epes, Ala. The river at this point is navigable.

The channel is straight for 400 feet above and 1,000 feet below the station. The current is swift. The right bank is a high stone bluff, clean, and not subject to overflow. The left bank is a high earth bank, which begins to overflow at gage height 38 feet. In floods it overflows for seven-eighths of a mile under the trestle. The bed of the stream is composed of soft blue stone, free from vegetation, and permanent. There is but one channel, broken by piers, until the left bank overflows. The depth of the stream is about 9 feet at low water.

Discharge measurements are made from the downstream side of the bridge, consisting of stationary span and draw span, with a trestle approach seven-eighths of a mile long at

the left bank. The initial point for soundings is the end of the draw span at the right bank, downstream side.

A standard chain gage is fastened to the downstream chord of the bridge, 150 feet from the right bank; length of the chain, 68.72 feet. A gage, graduated from 3.5 to 59 feet, is painted on the brick center pier. The chain gage is set to accord with the pier gage at 20 feet, the graduations of the latter not being accurate. The bench mark is the downstream end of the third crossbeam from the right end of the bridge; elevation, 65.65 feet above the datum of the gage.

Information in regard to a station formerly maintained at this point is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, pp 175-176; 65, p 286.
Discharge: 65, p 286.
Discharge, monthly: 75, p 98.
Gage heights: 48, p 176; 65, p 286.
Hydrograph: 75, p 98.
Rating table: 65, p 323.

Discharge measurements of Tombigbee River at Epes, Ala.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
1904.						
November 29	M. R. Hall	102	699	1.39	0.95	969
1905.						
February 22	J. M. Giles	576	12,500	3.57	43.0	44,630
February 23	do	576	11,860	3.45	42.3	40,960
February 23	do	576	12,150	3.51	42.4	42,580
May 19	M. R. Hall	180	1,687	3.05	6.43	5,149
June 26	W. E. Hall	173	1,587	3.14	5.69	4,976
December 22	do	250	3,630	4.15	15.57	15,070

Daily gage height, in feet, of Tombigbee River at Epes, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.0	15.5	39.6	7.2	16.6	5.7	5.9	2.9	4.4	1.3	2.8	2.2
2	8.5	15.0	37.8	6.8	18.8	5.3	7.8	4.0	3.2	2.45	2.55	2.2
3	8.0	15.3	34.7	6.4	18.8	4.4	8.8	5.6	2.75	2.4	2.35	2.25
4	7.5	15.7	28.5	6.2	17.6	3.6	8.6	4.6	3.0	1.95	2.25	2.35
5	6.5	21.5	22.0	7.8	16.4	3.2	8.8	4.1	2.6	4.7	2.05	3.6
6	6.0	26.5	14.7	10.2	15.0	2.85	9.2	3.7	2.6	4.0	1.9	4.4
7	5.5	28.5	11.2	11.5	12.7	2.6	8.5	3.15	2.6	3.5	1.9	4.8
8	5.5	38.3	9.2	11.4	13.6	2.35	7.8	3.05	2.8	3.3	1.8	4.9
9	5.5	39.9	8.8	11.1	16.6	2.3	7.1	2.8	2.8	3.3	1.8	4.7
10	7.5	41.5	14.4	10.8	18.1	2.65	6.1	2.85	2.4	2.9	1.8	4.3
11	19.5	42.6	18.0	11.0	18.1	2.4	5.7	3.4	2.0	2.8	2.25	3.95
12	24.0	43.6	18.6	14.4	17.6	2.05	7.7	8.2	2.0	3.9	3.85	3.65
13	26.5	44.7	18.8	16.7	17.1	2.0	8.1	12.6	2.7	4.3	5.4	3.45
14	27.0	45.2	19.8	16.2	15.8	2.4	7.0	13.1	4.5	4.3	5.5	3.45
15	26.5	45.5	20.6	15.2	13.5	2.9	6.2	12.0	3.25	4.2	5.6	4.5
16	25.9	45.6	20.8	15.2	9.6	2.1	5.0	10.8	3.2	4.3	5.6	9.8
17	25.0	45.5	18.7	14.0	7.7	2.0	4.1	9.9	3.05	6.6	4.8	13.6
18	24.5	45.5	15.1	12.2	6.9	3.35	3.15	10.6	2.85	6.8	4.0	13.7
19	24.0	44.9	12.0	10.8	6.6	4.3	2.8	10.6	2.5	5.9	3.45	11.9
20	22.0	44.2	12.1	10.0	5.9	4.2	2.5	10.2	2.15	5.4	3.1	12.3
21	15.5	43.5	16.3	9.2	5.6	4.2	1.95	8.6	1.9	4.8	2.85	14.0
22	13.0	42.9	19.6	10.0	5.9	3.85	1.65	6.9	2.6	3.65	2.75	15.6
23	10.5	42.2	22.8	10.5	8.4	3.8	1.6	6.4	2.6	2.8	2.55	15.7
24	9.5	41.5	22.4	10.2	9.3	4.2	1.7	6.2	2.2	2.4	2.5	15.4
25	8.5	41.0	21.5	12.2	7.9	5.0	1.65	6.1	2.0	2.2	2.4	15.1
26	6.5	40.5	19.2	16.6	10.5	5.8	2.2	6.9	1.85	2.0	2.4	14.6
27	6.1	40.2	17.2	15.0	13.9	6.6	2.5	7.6	1.65	1.85	2.25	13.8
28	6.5	40.0	14.6	12.6	11.8	6.9	2.6	8.8	1.6	2.25	2.2	13.8
29	10.0	.....	11.2	11.8	8.2	6.0	2.6	8.4	1.5	2.5	2.2	13.6
30	13.5	.....	9.3	12.6	6.8	6.2	3.3	7.5	1.3	2.7	2.2	12.7
31	14.5	.....	8.0	.....	6.7	.....	3.25	6.2	.....	3.0	.....	11.8

Station-rating table for Tombigbee River at Epes, Ala., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	1,195	2.40	1,855	3.50	2,690	4.60	3,680
1.40	1,250	2.50	1,925	3.60	2,780	4.70	3,775
1.50	1,305	2.60	1,995	3.70	2,870	4.80	3,870
1.60	1,360	2.70	2,065	3.80	2,960	4.90	3,965
1.70	1,420	2.80	2,140	3.90	3,050	5.00	4,060
1.80	1,480	2.90	2,215	4.00	3,140	5.20	4,250
1.90	1,540	3.00	2,290	4.10	3,230	5.40	4,450
2.00	1,600	3.10	2,370	4.20	3,320	5.60	4,652
2.10	1,660	3.20	2,450	4.30	3,410	5.80	4,856
2.20	1,725	3.30	2,530	4.40	3,500	6.00	5,060
2.30	1,790	3.40	2,610	4.50	3,590		

The above table is based on seven discharge measurements made during 1904-5. It is fairly well defined between gage heights 1.8 feet and 15 feet. Above gage height 6 feet the rating curve is a tangent, the difference being 104 per tenth.

Estimated monthly discharge of Tombigbee River at Epes, Ala., for 1905.

[Drainage area, 8,830 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	26,900	4,550	13,190	1.49	1.72
February	46,240	14,420	37,330	4.23	4.40
March	40,000	7,140	18,190	2.06	2.38
April	16,190	5,268	10,810	1.22	1.36
May	18,370	4,652	11,500	1.30	1.50
June	5,996	1,600	3,096	.351	.392
July	8,388	1,360	4,313	.488	.563
August	12,440	2,140	6,212	.704	.812
September	3,590	1,195	2,000	.226	.252
October	5,892	1,195	2,796	.317	.364
November	4,652	1,480	2,358	.267	.298
December	15,150	1,725	8,076	.915	1.05
The year	46,240	1,195	9,989	1.13	15.09

BLACK WARRIOR RIVER NEAR CORDOVA, ALA.

This station is located at the Kansas City, Memphis and Birmingham Railroad bridge, which crosses the river below the junction of Mulberry and Sipsey forks and about three-fourths mile from Cordova, Ala. The gage was established by the United States Weather Bureau.

The channel is curved for 500 feet above and straight for 1,000 feet below the station. The right bank is a rock bluff and will not overflow. The left bank overflows only under the second span of the bridge. The bed of the stream is of rock and is permanent. The channel has a width of about 180 feet at low water and about 450 feet at high stages.

Discharge measurements are made from the downstream side of the three-span railway bridge. The two spans across the river have a total length of 300 feet; the span on the left bank is 150 feet long. At low stages measurements are made from a boat or by wading at a point some distance below the bridge.

From 12 to 55 feet the gage is a vertical timber fastened to the inside of the bridge pier on the left bank of the river. Below 12 feet the gage was sloping, but it was out of position and could not be used when the station was established by the United States Geological Survey, May 21, 1900, so a section reading from −1.5 feet to +12.5 feet was fastened to a willow tree on the right bank of the river about 200 feet below the bridge. During 1905 this lower section of the gage was replaced by a section fastened to the rock on the right bank just below the bridge. Bench marks were established as follows: (1) The top of the fourth crossbeam from the right bank, on the downstream side; elevation, 60.09 feet. (2) A copper plug in the solid rock about 110 feet above the bridge, 50 feet from the initial point for soundings; elevation, 32.12 feet. (3) The top of the pier at the left bank; elevation, 55.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 171; 83, p 156; 98, p 161; 127, pp 163-164.
Discharge: 48, p 171; 83, p 157; 98, p 162; 127, p 164.
Discharge, monthly: 98, p 163; 127, p 166.
Gage heights: 48, p 172; 83, p 157; 98, p 162; 127, p 165.
Rating table: 65, p 323; 83, p 158; 98, p 163; 127, p 166.

Discharge measurements of Black Warrior River near Cordova, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 25	J. M. Giles	174	1,378	1.73	1.90	2,389
January 27	do	173	1,257	1.21	1.25	1,516
February 14	do	214	2,867	3.78	8.75	10,850
February 14	do	214	2,849	3.80	8.65	10,830
February 18	do	192	2,037	2.80	4.70	5,700
June 14	F. A. Murray	162	908	.43	−.27	389
August 9 [a]	B. S. Drane	183	572	.44	−.46	252
September 27 [b]	F. A. Murray	178	557	.60	−.26	336

[a] Measured from boat one-fourth mile below Frisco bridge.
[b] Measured from boat one-fourth mile above Frisco bridge.

Daily gage height, in feet, of Black Warrior River near Cordova, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	4.2	3.5	1.3	5.3	1.1	2.4	+0.2	0.8	−0.4	0.6	0.5
2	1.5	3.6	3.1	1.2	4.0	.8	2.0	.0	1.8	−.45	.5	.4
3	1.3	3.1	2.7	1.1	3.2	.6	1.8	−.1	7.0	−.6	.4	1.2
4	.9	2.7	2.5	1.0	2.7	.4	1.5	−.2	8.2	−.55	.4	2.7
5	.3	2.9	2.2	1.2	2.3	.3	1.2	−.3	4.0	−.5	.4	2.7
6	.4	14.3	2.0	1.3	1.9	.1	1.0	−.4	2.3	−.15	.4	2.0
7	1.5	14.2	1.9	1.4	3.8	.1	.8	−.4	2.6	.0	.4	1.5
8	1.6	13.9	1.8	1.3	7.7	.0	.6	−.5	1.0	−.15	.3	1.4
9	1.3	28.9	2.2	1.1	5.3	.0	.4	−.5	.9	−.3	.3	2.7
10	1.6	30.0	16.4	1.0	3.9	.0	.2	−.4	.6	−.45	.4	2.8
11	3.5	20.0	10.0	.9	3.1	.0	1.3	−.2	.5	.6	1.5	2.4
12	14.9	12.0	6.8	.8	2.4	−.1	.7	2.5	.5	3.6	1.5	2.0
13	19.3	10.0	5.2	.8	2.9	−.2	.5	1.0	1.0	1.9	1.3	1.9
14	12.9	8.8	4.2	.8	2.6	−.3	.3	1.7	1.5	.0	1.0	1.6
15	6.4	7.0	3.4	.8	1.8	−.3	.1	1.1	1.0	.6	.9	2.4
16	6.0	6.8	2.9	.9	2.3	.0	−.3	1.8	.5	1.2	.7	7.0
17	4.4	5.0	2.5	1.0	2.5	.0	−.3	2.3	.3	2.3	.6	6.8
18	3.2	4.8	2.3	.9	1.8	.0	−.4	3.0	.0	1.5	.5	5.5
19	2.5	4.3	2.1	.7	1.3	.0	−.5	1.6	.0	1.1	.4	3.7
20	2.7	6.8	2.4	.6	1.0	.0	−.6	3.6	.0	.8	.5	3.2
21	3.3	26.5	4.6	.6	1.0	.0	−.7	2.6	.1	.6	.5	5.7
22	2.9	22.8	5.5	1.1	2.2	.0	−.8	1.6	.5	.4	.4	7.3
23	2.3	13.2	4.5	1.3	3.7	.0	−.8	1.1	.3	.4	.5	6.6
24	2.1	9.1	3.8	1.0	3.9	.1	−.8	1.0	.0	.4	.6	7.4
25	2.0	6.9	3.3	.8	3.9	.1	+.4	2.5	−.1	.7	.6	6.8
26	1.6	5.5	2.9	1.5	3.0	.1	+.9	7.5	−.3	1.0	.3	5.7
27	1.3	4.6	2.5	3.6	9.5	.2	+.6	4.0	−.3	1.8	.3	4.2
28	1.2	4.0	2.2	3.5	4.1	.3	+.2	2.0	−.35	.7	.3	3.7
29	1.2	.....	2.0	2.5	2.5	3.3	−.2	1.3	−.35	.7	.3	4.6
30	3.6	.....	1.8	4.3	1.9	3.3	.0	1.0	−.35	.7	.5	4.0
31	5.1	.....	1.5	.....	1.4	.....	.4	1.0	.....	.7	.....	4.4

NOTE.—These gage heights are somewhat uncertain.

Station rating table for Black Warrior River near Cordova, Ala., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−1.00	28	.90	1,360	2.70	3,175	5.00	6,080
− .90	53	1.00	1,450	2.80	3,290	5.20	6,340
− .80	80	1.10	1,540	2.90	3,405	5.40	6,600
− .70	110	1.20	1,630	3.00	3,525	5.60	6,870
− .60	145	1.30	1,725	3.10	3,645	5.80	7,150
− .50	190	1.40	1,820	3.20	3,765	6.00	7,430
− .40	250	1.50	1,915	3.30	3,885	6.20	7,710
− .30	320	1.60	2,010	3.40	4,005	6.40	7,990
− .20	400	1.70	2,110	3.50	4,130	6.60	8,270
− .10	480	1.80	2,210	3.60	4,260	6.80	8,550
0.00	560	1.90	2,310	3.70	4,390	7.00	8,830
.10	645	2.00	2,410	3.80	4,520	7.20	9,110
.20	730	2.10	2,510	3.90	4,650	7.40	9,390
.30	820	2.20	2,615	4.00	4,780	7.60	9,670
.40	910	2.30	2,720	4.20	5,040	7.80	9,950
.50	1,000	2.40	2,830	4.40	5,300	8.00	10,230
.60	1,090	2.50	2,945	4.60	5,560	8.50	10,930
.70	1,180	2.60	3,060	4.80	5,820	9.00	11,650
.80	1,270						

The above table is based on discharge measurements made during 1900–1905. It is well defined to 14 feet. Above gage height 8.8 feet the rating curve is a tangent, the difference being 150 per tenth Below gage height 2.6 feet the table is the same as for 1904.

Estimated monthly discharge of Black Warrior River near Cordova, Ala., for 1905.

[Drainage area, 1,900 square miles]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	27,100	820	4,798	2.53	2.92
February	43,150	3,175	14,280	7.52	7.83
March	22,750	1,915	4,559	2.40	2.77
April	5,170	1,090	1,820	.958	1.07
May	12,400	1,450	3,889	2.05	2.36
June	3,885	320	880	.463	.517
July	2,830	80	957	.504	.581
August	9,530	190	1,908	1.00	1.15
September	10,510	285	1,753	.923	1.03
October	4,260	145	1,120	.589	.679
November	1,915	820	1,070	.563	.628
December	9,390	910	4,571	2.41	2.78
The year	43,150	80	3,468	1.83	24.32

NOTE.—See note to gage-height table, p. 143.

BLACK WARRIOR RIVER AT TUSCALOOSA, ALA.

A continuous record of gage heights at Tuscaloosa since 1889 has been kept by the United States Engineer Corps. During 1895 and 1896 a number of discharge measurements were also made, from which a rating table was obtained, and since that time measurements of flow have been made by the United States Geological Survey. The station is located about one-fourth mile above the Mobile and Ohio Railroad bridge. There are three locks and dams within a distance of 3 miles above the station.

The channel is straight for a long distance above and below the station; its width at low water is 280 feet and at high stages 625 feet. The current is sluggish at low stages. Both banks are high and steep and overflow only at extreme stages. The greater part of the bed is of rock and is permanent. There is but one channel, broi[illegible] the three bridge piers.

Discharge measurements are made from the iron highway bridge. The initial point for soundings is the end of the iron bridge on the left bank, downstream side.

A vertical iron gage is attached to the downstream side of the second pier from the left bank of the bridge from which discharge measurements are made. Gage heights are furnished by the United States Engineers.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 103-105; WS 15, p 57; 27, p 48; 36, p 156; 48, p 170; 65, p 284; 83, p 154; 98, pp 159-160; 127, p 167.

Discharge: Ann 18, iv, p 105; WS 15, p 57; 36, p 156; 65, p 284; 98, p 160; 127, p 168.

Discharge, monthly: Ann 18, iv, p 108; 19, iv, p 251; 20, iv, p 194; 21, iv, p 153; 22, iv, p 207; WS 75, p 96; 83, p 156.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: WS 11, pp 37-40; 15, p 57; 27, p 56; 36, p 157; 48, p 171; 65, p 285; 83, pp 154-155; 98 p 160; 127, p 168.

Hydrographs: Ann 18, iv, p 108; 19, iv, p 252; 20, iv, p 195; 21, iv, p 153.

Rating tables: Ann 18, iv, pp 106-107; 19, iv, p 251; WS 27, p 58; 39, p 445; 52, p 514; 65, p 323; 83, p 155

Discharge measurements of Black Warrior River at Tuscaloosa, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 20	J. M. Giles	454	9,872	1.37	25.45	13,500
February 21	do	507	19,320	3.15	44.75	60,930
February 24	do	495	16,660	1.52	39.55	25,340
February 25	do	484	13,440	1.26	33.00	16,880
June 27	W. E. Hall	250	1,807	1.06	6.85	1,900
July 11	do	251	1,860	1.35	7.15	2,510

Daily gage height, in feet, of Black Warrior River at Tuscaloosa, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.1	19.2	21.4	9.41	15.75	9.15	15.35	6.25	7.6	5.0	6.15	5.72
2	10.11	17.1	18.59	8.95	16.5	8.95	12.8	6.35	6.7	4.9	5.92	5.9
3	9.55	15.1	15.8	8.68	15.02	8.2	12.25	6.55	8.75	4.9	5.8	6.55
4	8.4	13.75	13.5	8.4	13.3	7.05	10.75	6.2	15.3	5.0	5.7	7.65
5	7.9	13.15	12.0	8.5	11.85	6.58	8.75	5.85	18.05	4.95	5.5	9.7
6	7.75	31.8	11.3	8.75	10.68	6.25	7.53	5.62	14.0	4.92	5.45	10.45
7	7.65	40.4	10.65	8.9	10.4	5.95	7.25	5.45	10.7	5.2	5.35	9.55
8	8.6	40.0	10.35	8.95	12.35	5.8	7.15	5.55	8.75	5.5	5.3	8.8
9	9.25	55.35	10.4	15.5	18.0	5.65	7.35	5.25	7.65	5.5	5.2	8.35
10	9.1	56.9	15.1	13.2	16.8	5.1	7.0	5.2	6.95	5.4	5.3	9.1
11	10.05	54.45	27.12	11.1	14.35	5.08	7.02	6.35	6.45	5.42	5.3	10.15
12	20.8	48.98	23.6	9.85	12.35	5.06	9.5	6.9	6.2	5.65	5.75	10.0
13	45.6	44.75	19.3	9.3	10.81	5.04	12.25	9.45	6.2	8.4	6.78	9.35
14	46.07	42.98	16.21	9.0	10.11	5.0	11.75	10.65	6.45	8.25	7.0	8.9
15	40.2	39.35	13.85	8.5	9.8	5.4	9.6	9.8	6.65	7.35	6.72	9.1
16	33.51	35.25	12.45	8.6	9.7	5.35	8.0	9.65	6.6	6.75	6.4	10.8
17	27.6	31.59	11.42	8.6	9.91	5.4	6.9	9.25	6.2	6.65	6.22	16.1
18	23.31	28.68	10.82	8.4	10.02	6.35	6.25	11.25	5.8	7.7	6.03	16.2
19	19.5	26.45	10.15	8.21	11.75	7.4	5.9	11.0	5.55	7.72	5.9	14.5
20	16.4	25.0	10.2	7.85	9.8	6.4	5.6	10.15	5.4	7.2	5.82	13.12
21	15.1	39.98	14.5	7.65	9.2	6.11	5.41	13.3	5.3	6.65	5.75	13.02
22	14.02	47.65	21.05	7.72	9.95	5.75	5.25	16.85	5.25	6.23	5.6	17.8
23	12.7	45.2	21.62	8.05	13.15	5.85	5.1	9.7	5.8	5.9	6.0	21.15
24	11.65	39.9	18.8	8.32	15.82	7.25	5.25	8.75	5.6	5.72	5.9	20.9
25	11.2	34.9	16.2	8.15	14.81	6.9	6.42	8.5	5.4	5.6	5.8	22.6
26	10.1	30.5	14.35	9.13	14.6	7.28	9.35	15.55	5.3	5.6	5.72	20.6
27	9.7	27.05	13.35	10.88	14.51	6.98	8.75	23.0	5.15	5.9	5.6	17.6
28	9.1	24.2	12.03	13.4	20.2	6.7	7.4	17.4	5.3	6.25	5.61	15.35
29	8.5	.....	11.2	13.81	16.0	7.8	6.58	12.5	4.95	7.0	5.7	15.15
30	12.15	.....	10.53	13.25	12.51	14.45	6.22	9.65	4.9	6.75	5.8	15.15
31	19.1	.....	9.95	.....	10.5	.....	6.17	8.1	.....	6.45	.....	16.7

CLEAR CREEK NEAR ELK, ALA.

This station was established June 22, 1904, by M. R. Hall. It is located at the wagon bridge 1 mile south of Elk and 15 miles north of Jasper, on the road to Houston. The bridge is about one-fourth mile above Clear Creek Falls and 2 miles above the junction of Clear Creek with Sipsey Fork of Black Warrior River. This station is maintained in cooperation with the Alabama Geological Survey, by which the gage reader is paid.

The channel is straight for about 400 feet above and 500 feet below the station. The current above the station is rather sluggish at low stages; below, it is swift and broken. The right bank is low, wooded, and is liable to overflow, but all the water passes under the bridge and trestle. The left bank is high, rocky, clean, and is not subject to overflow. The bed of the stream is composed of rock and clean sand and is permanent. There is one channel at all stages.

Discharge measurements are made from the upstream side of the bridge. This is an iron bridge, having a single span of 100 feet and a 49-foot trestle approach on the right bank. The initial point for soundings is the end of the bridge at the left bank, on the upstream side. At very low water the current is too sluggish for measurement at the bridge, but measurements are made by wading at the falls below.

The gage is a vertical timber fastened to the right side of the right-bank stone pier under the upstream side of the bridge. It is read once each day by J. S. Gossett. Bench marks were established as follows: (1) The top of the outer, upstream eyebar, at a point

35 feet from the initial point for soundings; elevation, 17.10 feet. (2) A copper plug set in rock on the left bank about 15 feet upstream from the end of the bridge; elevation, 17.04 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 127, pp. 169–170.

Discharge measurements of Clear Creek near Elk, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 28	J. M. Giles	96	109	0.98	0.97	106
January 28	do	96	109	.95	.95	104

Daily gage height, in feet, of Clear Creek near Elk, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	1.3	1.3	1.1	1.6	1.0	1.1	0.9	0.8	0.8	1.0	1.0
2	1.0	1.3	1.2	1.1	1.4	.9	.9	.9	1.9	.8	1.0	1.0
3	.9	1.2	1.2	1.1	1.3	.9	.9	.9	1.4	.9	1.0	1.1
4	.9	1.2	1.2	1.1	1.2	.9	1.0	.8	1.3	.9	1.0	1.1
5	.9	1.5	1.2	1.1	1.2	.9	1.2	.8	1.1	.9	1.0	1.0
6	.9	2.7	1.2	1.1	1.2	.9	1.0	.8	1.0	.9	.9	1.0
7	.9	2.2	1.1	1.1	1.5	.9	.9	.8	1.0	.8	.9	1.0
8	1.1	3.8	1.0	1.1	1.4	.8	1.0	.8	.9	.8	.9	1.1
9	1.0	4.6	3.3	1.1	1.3	.8	.9	.8	.9	.8	.9	1.1
10	1.1	2.5	3.0	1.1	1.2	.8	.9	.8	.9	1.1	1.4	1.1
11	1.6	2.1	2.4	1.0	1.2	.8	1.3	.8	.9	1.8	1.3	1.1
12	3.1	1.9	1.8	1.0	1.1	.8	1.2	.8	1.0	1.6	1.2	1.0
13	2.3	1.9	1.5	1.0	1.3	.8	1.1	1.1	1.0	1.3	1.1	1.0
14	1.8	1.8	1.4	1.0	1.1	.8	1.0	1.1	.9	1.1	1.1	1.1
15	1.5	1.7	1.4	1.0	1.1	.9	.9	1.1	.9	1.1	1.1	1.6
16	1.3	1.6	1.3	1.2	1.1	1.1	.9	1.1	.9	1.4	1.1	1.8
17	1.3	1.5	1.3	1.1	1.1	1.0	.9	1.3	.8	1.3	1.0	1.7
18	1.2	1.4	1.2	1.0	1.1	1.1	.9	1.0	.8	1.1	1.0	1.5
19	1.2	1.4	1.3	1.0	1.0	1.0	.8	1.0	1.4	1.1	1.0	1.4
20	1.3	5.2	1.3	1.0	1.0	.9	.8	1.0	1.1	1.1	1.0	1.4
21	1.2	3.3	1.8	1.0	1.0	.9	.8	1.0	1.1	1.0	1.0	1.8
22	1.2	2.3	1.6	1.2	1.2	.9	.8	1.0	1.0	1.0	1.0	1.6
23	1.1	2.0	1.4	1.1	1.1	1.0	.7	1.0	1.0	1.0	1.0	1.9
24	1.1	1.8	1.4	1.1	1.2	.9	.9	.9	.9	1.0	.9	1.9
25	1.1	1.7	1.3	1.1	1.2	.9	1.7	1.0	.9	1.0	1.0	1.6
26	1.0	1.6	1.3	1.3	1.1	.9	1.2	1.0	.8	1.3	1.0	1.5
27	1.0	1.5	1.3	1.3	1.1	.9	1.0	1.0	.8	1.2	1.0	1.5
28	.9	1.4	1.2	1.2	1.0	.9	.9	.9	.8	1.1	1.0	1.4
29	1.0	.....	1.2	1.1	1.0	.9	.9	.9	.8	1.1	1.0	1.4
30	1.5	.....	1.2	1.8	1.0	.9	.9	.9	.8	1.1	1.0	1.3
31	1.4	.....	1.1	.....	1.0	.....	.9	.9	.....	1.0	.....	1.3

Station rating table for Clear Creek, near Elk, Ala., from June 23, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	12	0.80	44	1.00	128	1.10	188
.70	24	.90	76				

The above table is based on seven discharge measurements made during 1904-5. It is fairly well defined. The above table covers the low-water period. As no high-water measurements have been made, the monthly estimates have not been made.

LOCUST FORK OF BLACK WARRIOR RIVER AT PALOS, ALA.

Locust Fork of Black Warrior River rises in Blount County, Ala., and, flowing in a southwesterly course, enters Black Warrior River a short distance above Wilmington, Ala. Its drainage basin is hilly, and only a small part of its area is in cultivation. The Palos station was established November 26, 1901, by the United States Engineer Corps, who furnish the daily gage heights to the United States Geological Survey.

The channel is curved for 1,500 feet above the station and is straight for 3,000 feet below. At low water the channel is 180 feet wide. There is a ledge of rock about 200 feet below the station, with about 3 feet fall. Both banks are high and wooded. The right bank overflows at flood stages, but only under the approach to the bridge. The bed is mainly of rock and is permanent.

Discharge measurements are made from the mining railroad bridge of the Drennan Coal Mining Company, about one-fourth mile below the Kansas City, Memphis and Birmingham Railroad bridge. The bridge has two iron spans of 100 feet each and trestle approaches at both ends. Low-water measurements are made by wading, at a shoal one-third mile below the bridge. The initial point for soundings is the left-bank end of the iron bridge on the downstream side.

The gage is situated on the right bank of the river, just below the Kansas City, Memphis and Birmingham Railroad bridge. It is in two sections, the lower or inclined section reading from 0 to 17 feet vertically, and the upper or vertical section reading from 17 to 32 feet. The datum of the gage (251.71 feet above Mobile datum) is supposed to be extreme low water. High water, April, 1900, was about 37 feet. Bench marks were established as follows: (1) The top of the crossbeam at a point 80 feet from the left end of the bridge on the downstream side; elevation, 46.70 feet. (2) A copper plug in a water-oak tree on the right bank, 20 feet downstream from the gage; elevation, 21.68 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, p 159; 98, p 164; 127, pp 171-172.
Discharge: 83, p 159; 98, p 165; 127, p 172.
Discharge, monthly: 83, p 161; 98, p 166; 127, p 174.
Gage heights: 83, p 160; 98, p 165; 127, p 173.
Rating table: 83, p 160; 98, p 166; 127, p 173.

Discharge measurements of Locust Fork of Black Warrior River at Palos, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 27[a]	J. M. Giles	175	570	3.87	2.02	2,205
February 27	do	157	1,507	1.64	1.98	2,465
June 15	F. A. Murray	151	943	.51	.72	484
August 10	B. S. Drane	155	351	.83	.50	291
August 10[a]	do	155	363	.84	.50	304
September 26[a]	F. A. Murray	127	280	.46	.30	129

[a] Measured at Frisco Railroad bridge.

Daily gage height, in feet, of Locust Fork of Black Warrior River at Palos, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.7	1.9	1.0	1.4	1.1	2.0	0.7	0.7	0.2	0.5	0.8
2	1.0	1.6	1.9	.9	1.4	1.0	1.8	.7	.9	.2	.4	.8
3	1.0	1.4	1.8	.9	1.2	.9	2.0	.7	1.4	.2	.4	1.2
4	.9	1.3	1.6	.8	1.1	.8	1.4	.6	1.8	.4	.4	1.6
5	.9	1.4	1.4	.9	1.1	.7	1.1	.5	1.4	.9	.4	2.0
6	.8	6.9	1.3	1.0	1.0	.7	1.0	.4	1.0	.9	.4	1.9
7	1.0	5.0	1.2	1.0	1.2	.6	1.0	.3	.9	.8	.4	1.8
8	1.2	5.8	1.1	1.1	1.7	.6	1.2	.3	.5	.8	.4	1.8
9	1.1	20.9	1.2	1.0	1.8	.5	1.0	.2	.6	.9	.4	2.1
10	1.1	19.0	1.3	.9	1.5	.5	.9	.5	.6	.9	.5	1.7
11	1.6	10.1	1.4	.9	1.2	.4	1.7	.5	.5	.9	.7	1.7
12	5.2	5.0	1.3	.9	1.1	.4	3.3	.6	.7	.8	.8	1.6
13	12.1	5.0	1.2	.8	1.1	.4	2.5	1.0	.7	.7	.9	1.3
14	7.2	4.9	1.1	.8	1.1	.5	1.7	1.5	.7	.6	.7	1.1
15	4.1	4.2	1.1	.8	1.0	.7	1.3	1.0	.6	.7	.7	1.3
16	2.6	3.5	1.0	.9	1.6	1.5	1.0	1.7	.6	.8	.7	1.7
17	2.0	2.9	1.0	.9	2.5	1.1	.9	1.5	.5	.9	.6	1.9
18	1.7	2.6	.9	.8	2.0	.9	.8	1.1	.5	.9	.6	1.6
19	1.6	2.0	.9	.8	1.6	.8	.7	1.0	.4	.8	.6	1.3
20	1.7	3.5	1.0	.7	1.3	.7	.8	1.0	.4	.8	.5	1.4
21	1.6	8.3	2.4	.7	1.4	.6	.7	2.0	.4	.7	.6	2.5
22	1.3	7.4	2.8	.9	1.8	1.5	.5	1.0	.4	.7	.6	3.7
23	1.3	4.9	2.1	1.0	2.4	1.4	.5	.9	.4	.6	.6	3.3
24	1.2	3.5	1.8	.9	2.0	1.3	.4	1.0	.3	.6	.6	3.0
25	1.2	2.8	1.6	.8	2.2	1.5	.8	3.2	.3	.6	.6	2.5
26	1.1	2.4	1.4	.9	2.1	1.0	.6	4.4	.3	.6	.6	2.2
27	1.0	2.2	1.3	1.0	2.7	1.3	.6	2.1	.3	.5	.6	1.9
28	1.9	2.0	1.2	1.1	2.1	1.4	.6	1.3	.2	.5	.7	1.7
29	.9	.....	1.2	1.0	1.7	4.3	.5	1.2	.2	.6	.8	2.0
30	1.8	.....	1.1	1.2	1.4	3.1	.5	1.1	.2	.5	.8	2.1
31	1.9	.....	1.1	.....	1.2	.....	1.0	.9	.....	.5	.....	1.7

Station rating table for Locust Fork of Black Warrior River at Palos, Ala., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	34	1.10	935	2.10	2,530	3.20	4,560
.10	67	1.20	1,070	2.20	2,710	3.40	4,940
.20	110	1.30	1,210	2.30	2,890	3.60	5,320
.30	165	1.40	1,360	2.40	3,070	3.80	5,700
.40	230	1.50	1,515	2.50	3,250	4.00	6,100
.50	305	1.60	1,680	2.60	3,430	4.20	6,500
.60	390	1.70	1,850	2.70	3,610	4.40	6,900
.70	480	1.80	2,020	2.80	3,800	4.60	7,300
.80	580	1.90	2,190	2.90	3,990	4.80	7,700
.90	690	2.00	2,360	3.00	4,180	5.00	8,100
1.00	810						

The above table is based on 21 discharge measurements made during 1902–1905. It is well defined between gage heights —0.1 foot and 5 feet. Above gage height 5 feet the rating curve is a tangent, the difference being 200 per tenth.

Estimated monthly discharge of Locust Fork of Black Warrior River at Palos, Ala., for 1905.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	22,300	580	2,767	2.71	3.12
February	39,900	1,210	8,381	8.22	8.56
March	3,800	690	1,417	1.39	1.60
April	1,070	480	707	.693	.773
May	3,610	810	1,686	1.65	1.90
June	6,700	230	1,049	1.03	1.15
July	4,750	230	1,089	1.07	1.23
August	6,900	110	1,143	1.12	1.29
September	2,020	110	459	.450	.502
October	690	110	463	.454	.523
November	690	230	383	.375	.418
December	5,510	580	2,145	2.10	2.42
The year	39,900	110	1,807	1.77	23.49

MISCELLANEOUS MEASUREMENTS IN MOBILE RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Mobile River drainage basin during 1905:

Big Sandy Creek near Dadeville, Ala.—A measurement was made June 7, 1905, from the upstream side of Hall's wagon bridge, near Dadeville, Ala. The bench mark is the top of the outside wooden stringer on the upstream side of the bridge at the first vertical post from the left-bank pier; elevation, 26.00 feet above the datum of the assumed gage.

Width, 73 feet; area, 127 square feet; mean velocity, 0.34 foot per second; gage height, 1.65 feet; discharge, 44 second-feet.

Big Wills Creek near Attalla, Ala.—A measurement was made July 28, 1905, from the downstream side of Ray's bridge, about 2½ miles from Attalla, Ala. The bench mark is the top of the downstream end of the second-floor beam from the right end of the second

span from the right-bank end of the bridge; elevation, 25.00 feet above the datum of the assumed gage.

Width, 30 feet; area, 73 square feet; mean velocity, 1.49 feet per second; gage height, 3.77 feet; discharge, 109 second-feet.

Black Water Creek near Jasper, Ala.—A discharge measurement was made January 28, 1905, from the upstream side of a single-span iron highway bridge, 100 yards below the dam at Camack's mill, 6 miles north of Jasper, Ala. The initial point for soundings is the end of the bridge at the right-bank upstream side. The bench mark is the top of the upstream eyebar, 49 feet from the right-bank end of the bridge; elevation, 20.00 feet above the datum of the assumed gage.

Width, 68 feet; area, 83 square feet; mean velocity, 1.18 feet per second; gage height, 1.8 feet; discharge, 98 second-feet.

Buck Creek near Helena, Ala.—A measurement was made April 3, 1905, from the footbridge and log across Buck Creek at point opposite Helena, Ala. The bench mark is the top of tie or base of rail at second crossbeam from the left bank at the Louisville and Nashville Railroad bridge; elevation, 22.00 feet above the datum of the assumed gage.

Width, 73 feet; area, 70 square feet; mean velocity, 1.00 foot per second; gage height, 1.75 feet; discharge, 69 second-feet.

Cahaba River near Tacoa, Ala.—Two measurements were made April 3, 1905, near Tacoa, Ala. The bench mark is the base of rail on the Louisville and Nashville Railroad bridge over the third crossbeam from the center pier; elevation, 49.00 feet above the datum of the assumed gage.

At section 500 feet above Louisville and Nashville Railroad bridge: Width, 64 feet; area, 268 square feet; mean velocity, 0.62 foot per second; gage height, 4.65 feet; discharge, 167 second feet.

At section 1,000 feet below mouth of Buck Creek: Width, 116 feet; area, 146 square feet; mean velocity, 1.55 feet per second; gage height, 4.65 feet; discharge, 227 second-feet.

Cedar Creek near Cavespring, Ga.—This stream enters Coosa River about 6 miles northwest of Cavespring, Ga. A measurement was made July 25, 1905, from the upstream side of a single-span steel bridge 2½ miles northwest of Cavespring and one-fourth mile above the Southern Railway bridge. The bench mark is the top of the upstream end of the second iron floor beam from the right end of the bridge; elevation, 17.00 feet above the datum of the assumed gage.

Width, 68 feet; area, 186 square feet; mean velocity, 0.42 foot per second; gage height, 3.13 feet; discharge, 77 second-feet.

Hillabee Creek near Alexander City, Ala.—A regular station was formerly maintained at a wooden wagon bridge 6½ miles northeast of Alexander City, Ala., on the road leading to Newsite. The old gage is still in place. A measurement was made June 9, 1905.

Width, 135 feet; area, 194 square feet; mean velocity, 0.62 foot per second; gage height, 1.15 feet, discharge, 120 second-feet.

Luxapelila Creek at Columbus, Miss.—This stream enters Tombigbee River at Columbus, Miss. A measurement was made November 24, 1905, from the downstream side of the Mobile and Ohio Railroad bridge. The bench mark is the top of the downstream end of the first floor beam from the right end of the steel truss; elevation, 35.00 feet above the datum of the assumed gage.

Width, 110 feet; area, 710 square feet; mean velocity, 0.33 foot per second; gage height, 3.92 feet; discharge, 234 second-feet.

PEARL RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Pearl River rises in the eastern part of Mississippi. It flows south into Lake Borgne, an arm of the Gulf of Mexico, forming part of the boundary between Louisiana and Mississippi.

The following pages give the results of the data collected in this drainage during 1905:

PEARL RIVER AT JACKSON, MISS.

This station was established June 24, 1901, by K. T. Thomas. It is located at a highway bridge, 2 miles from the union station at Jackson, Miss., one-eighth mile above the Alabama and Vicksburg Railroad, and two blocks east from the end of the South State street car line.

The channel makes a 90° curve about 200 feet above the bridge. It is nearly straight for about one-fourth mile below the bridge. The right bank is high and rocky and does not overflow. The left bank is of cleared ground and overflows at about 20 feet gage height. The width of the stream at low stages is about 130 feet and at flood stages about 900 feet. The bed is of sand and gravel and is shifting. The current velocity is moderate, but is not well distributed, and is broken by an old pier and some short piles under the bridge.

Discharge measurements are made from the single-span highway bridge and from an approach of 680 feet of iron trestle on the left bank. The initial point for soundings is the end of the bridge on the right bank. At low stages the discharge can be measured by wading about one-fourth mile above the bridge

The original chain gage was fastened to the downstream side of the bridge at a point 130 feet from the initial point for soundings. On July 14, 1905, this was superseded by a standard chain gage, fastened to the downstream lower chord of the bridge, in the fifth panel from the right-bank end of the main span; length of chain, 42.08 feet. The datum of this gage is the same as that of the original gage; the bottom of the gage box at the pulley is 40.08 feet above the datum of the gage. Bench marks were established as follows: (1) The downstream end of the top of the iron floor beam, 120 feet from the right-bank end of the bridge; elevation, 39.00 feet. The elevation of the bridge floor at this point is 40.15 feet. (2) A cross marked on the top of the downstream tubular pier at the right bank; elevation, 38.88 feet. (3) The top of the upstream latticed iron post supporting the right end of the bridge; elevation, 39.11 feet. (4) The head of a small bolt driven vertically into the base of an ash tree on the sidewalk on South Jefferson street, about 130 feet from north corner of Silas Brown street; elevation, 52.74 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey as follows:

Description: 65, p 286; 83, p 164; 98, p 170; 127, pp 177-178.
Discharge: 65, p 286; 83, p 165; 98, p 171; 127, p 178.
Discharge, monthly: 98, p 172; 127, p 180.
Gage heights: 65, p 287; 83, p 165; 98, p 171; 127, p 179.
Rating table: 98, p 172; 127, p 179.

Discharge measurements of Pearl River at Jackson, Miss., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 16	J. M. Giles	1,272	14,600	1.69	29.05	24,710
February 17	do	1,272	14,750	1.68	29.15	24,690
June 24	W. E. Hall	113	473	1.21	2.50	574
July 14	do	117	503	1.25	2.50	630

Daily gage height, in feet, of Pearl River at Jackson, Miss., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	7.0	21.3	13.0	18.6	5.7	5.1	1.8	5.7	3.7	2.5	1.8
2	3.5	6.4	20.1	11.4	18.5	5.2	4.9	1.9	5.2	3.5	2.4	1.8
3	3.6	6.0	18.8	10.6	18.0	5.0	4.8	1.7	4.2	2.7	2.3	1.9
4	3.5	6.2	17.9	11.8	17.5	4.4	4.7	2.4	3.9	3.7	2.4	1.8
5	3.4	9.2	15.4	12.7	16.8	4.2	4.4	3.0	3.3	4.0	3.5	1.8
6	3.3	14.7	13.5	13.0	15.6	3.7	4.0	3.4	3.0	4.5	3.4	1.7
7	3.1	15.8	12.1	12.1	13.8	3.4	3.6	3.0	2.8	3.2	3.5	1.8
8	2.9	19.1	10.5	12.2	12.7	3.1	3.3	2.6	2.5	3.2	2.9	1.8
9	2.9	22.3	9.7	11.4	11.6	2.9	3.0	2.4	2.3	2.0	2.8	1.9
10	2.9	24.1	8.8	11.0	10.8	2.8	2.9	2.3	2.0	2.2	3.8	2.0
11	2.9	25.0	9.0	11.7	10.0	2.7	2.8	2.2	2.0	3.0	4.5	2.1
12	5.5	25.8	8.7	13.8	9.5	2.4	2.7	2.3	3.0	4.4	4.2	2.1
13	6.1	26.9	8.5	14.7	9.3	2.4	2.4	2.5	1.9	5.0	3.9	2.2
14	6.6	27.7	8.2	15.7	9.6	2.3	2.4	3.6	1.9	4.8	3.3	4.4
15	7.3	28.6	8.1	15.8	11.7	2.2	2.5	3.3	1.7	4.2	3.3	7.3
16	7.0	29.0	8.0	14.8	12.6	2.2	2.5	3.4	1.6	5.2	3.1	6.6
17	7.0	29.2	7.9	14.8	11.7	2.1	2.4	3.3	1.6	5.4	2.9	6.0
18	7.3	28.9	7.6	14.7	11.6	2.1	2.3	3.3	1.4	5.5	2.8	5.7
19	7.4	28.6	10.2	14.4	10.5	2.1	2.2	3.8	1.5	5.3	2.8	5.9
20	7.5	28.8	10.5	14.1	9.2	2.0	2.0	4.1	1.6	5.2	2.7	6.1
21	7.1	28.7	13.5	13.8	8.2	2.1	2.0	5.2	1.5	4.7	2.6	6.6
22	6.6	28.2	14.8	13.1	7.7	2.2	1.9	5.0	1.5	4.1	2.5	7.5
23	6.1	27.5	16.8	12.4	11.1	2.3	1.9	4.9	1.4	3.7	2.4	8.2
24	5.9	26.6	17.4	11.7	12.2	2.7	1.8	4.9	1.4	3.5	2.3	7.9
25	5.9	25.7	17.9	13.9	12.5	2.7	2.6	4.9	1.4	3.4	2.2	7.4
26	5.8	24.6	17.9	16.5	12.8	3.0	2.7	4.9	1.3	3.5	2.1	7.1
27	5.1	23.6	17.3	17.2	12.0	3.2	2.0	4.8	1.3	3.1	2.0	6.8
28	5.2	22.7	16.5	17.6	10.1	3.5	2.5	4.8	1.3	3.0	1.9	6.6
29	5.2	.....	15.9	17.7	8.2	4.5	2.4	5.3	1.2	2.8	1.9	6.3
30	7.5	.....	15.5	17.9	7.3	5.1	2.1	5.7	1.1	2.6	1.8	6.0
31	6.8	.....	14.3	.....	6.5	.....	1.8	5.8	.....	2.6	.....	6.4

Station rating table for Pearl River at Jackson, Miss., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	80	2.80	710	5.60	2,090	12.50	6,260
.40	88	2.90	753	5.80	2,200	13.00	6,600
.50	97	3.00	797	6.00	2,310	13.50	6,950
.60	108	3.10	842	6.20	2,420	14.00	7,300
.70	120	3.20	888	6.40	2,530	14.50	7,650
.80	133	3.30	935	6.60	2,640	15.00	8,000
.90	147	3.40	982	6.80	2,750	15.50	8,350
1.00	162	3.50	1,030	7.00	2,860	16.00	8,700
1.10	178	3.60	1,078	7.20	2,970	16.50	9,100
1.20	196	3.70	1,126	7.40	3,080	17.00	9,500
1.30	216	3.80	1,174	7.60	3,195	17.50	9,900
1.40	238	3.90	1,223	7.80	3,315	18.00	10,300
1.50	262	4.00	1,272	8.00	3,435	19.00	11,100
1.60	288	4.10	1,321	8.20	3,555	20.00	12,000
1.70	316	4.20	1,370	8.40	3,675	21.00	12,900
1.80	345	4.30	1,420	8.60	3,795	22.00	13,900
1.90	375	4.40	1,470	8.80	3,915	23.00	15,000
2.00	407	4.50	1,520	9.00	4,035	24.00	16,200
2.10	440	4.60	1,570	9.50	4,335	25.00	17,500
2.20	475	4.70	1,620	10.00	4,635	26.00	19,000
2.30	511	4.80	1,670	10.50	4,960	27.00	20,700
2.40	548	4.90	1,720	11.00	5,285	28.00	22,600
2.50	587	5.00	1,770	11.50	5,610	29.00	24,500
2.60	627	5.20	1,870	12.00	5,935	30.00	26,400
2.70	668	5.40	1,980				

The above table is based on 18 discharge measurements made during 1901–1905. It is well defined between gage heights 0.3 foot and 8.3 feet. The table has been extended beyond these limits, being based on one measurement at 24 feet and two at 29 feet. Below 10 feet the table is the same as for 1904.

Estimated monthly discharge of Pearl River at Jackson, Miss., for 1905.

[Drainage area, 3,120 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	3,135	753	1,963	0.629	.725
February	24,880	2,310	16,100	5.16	5.37
March	13,200	3,195	7,005	2.25	2.59
April	10,220	5,025	7,236	2.32	2.59
May	10,780	2,585	5,959	1.91	2.20
June	2,145	407	894	.287	.320
July	1,820	345	769	.246	.284
August	2,200	316	1,126	.361	.416
September	2,145	178	549	.176	.196
October	2,035	407	1,189	.381	.439
November	1,520	345	741	.238	.266
December	3,555	316	1,694	.543	.626
The year	24,880	178	3,769	1.21	16.02

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 168.]

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1888. Tenth Annual Report, Part II.
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1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
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UNITED STATES GEOLOGICAL SURVEY,
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APRIL, 1906.

O

Water-Supply and Irrigation Paper No. 169 Series P, Hydrographic Progress Reports, 45

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART V.—Ohio and Lower Eastern Mississippi River Drainages

BY

M. R. HALL, F. W. HANNA, and J. C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART V.

By M. R. Hall, F. W. Hanna, and J. C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Stat. L., vol. 28, p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. There is also collected information concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely upon the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information

concerning the minimum flow; if the water is to be stored the maximum flow receives special attention. In all sections of the country permanent stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. "The Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165-178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and Eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based upon the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor Northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear	Minor Southern Atlantic.

List of drainage basins in the United States—Continued.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor Eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE DRAINAGE BASINS.

Lake Superior.	Niagara River
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor Western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharge," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-foot. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the two remaining columns, which are defined on page 9, are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5 and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5 and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep; 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equals 15 United States gallons per second.
100 California miner's inches equals 77 Colorado miner's inches.
100 California miner's inches for one day equals 4 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 130 California miner's inches.
100 Colorado miner's inches for one day equals 5.2 acre-feet.
100 United States gallons per minute equals .223 second-foot.
100 United States gallons per minute for one day equals 0.44 acre-feet.
1 million United States gallons per day equals 1.55 second-feet.
1 million United States gallons equals 3.07 acre-feet.
1 million cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch, equals 1 ton per square foot, equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.
To calculate water power quickly: $\frac{\text{Sec.-ft. x fall in feet}}{11}$=net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$: l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:
Scale 1:125000, 1 mile=0.50688 inch.
Scale 1: 90000, 1 mile=0.70400 inch.
Scale 1: 62500, 1 mile=1.01376 inches.
Scale 1: 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data upon which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{r\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n, which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash boards, or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured either by a weir, a current meter, or a simple system of water wheels which are of standard make or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve for a critical stage of considerable duration the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

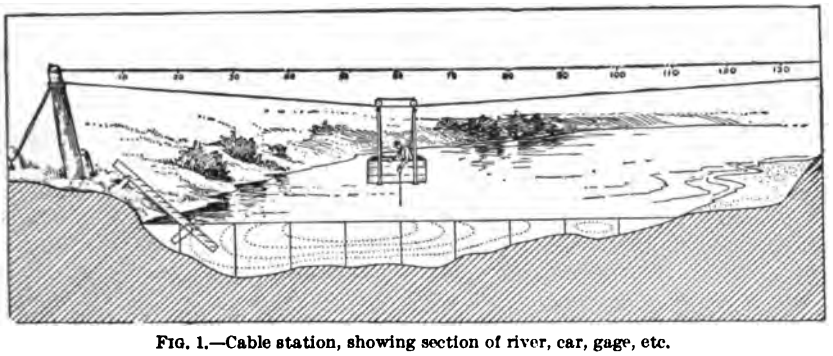

FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same, whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams, dams, or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as equipment. These are: A gage for determining the fluctuations of the water surface; bench marks, to which the datum of the gage is referred; permanent marks on a bridge or a tagged line indicating the points of measurement, and where the current is swift some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, a boat, or by wading, and gaging stations may be classified in accordance with such use. (Fig. 1 shows a typical cable station.)

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method can be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in figure 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to the lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

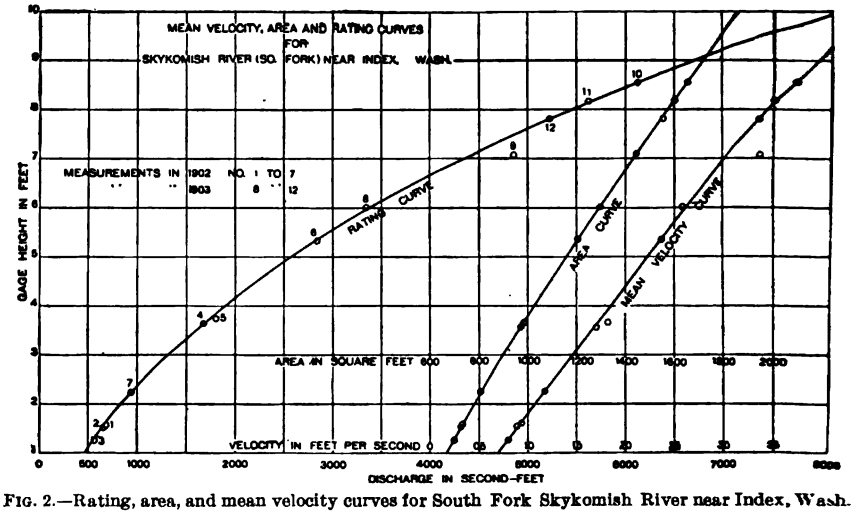

FIG. 2.—Rating, area, and mean velocity curves for South Fork Skykomish River near Index, Wash.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river

at the time of measurement, the area of the cross section, the mean veloctiy of the current, and the quantity of the water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends upon the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant; (2) neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; (3) the discharge is a function of and increases gradually with the stage.

The plotting of the results of the various discharge measurements using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean volocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Figure 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height, or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in anyway, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Alabama.—District hydrographer, M. R. Hall,[a] assisted by W. E. Hall and F. A. Murray.

Illinois.—District hydrographer, F. W. Hanna,[b] assisted by M. S. Brennan and Sidney K. Clapp.

Indiana.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K. Clapp. Acknowledgment should also be made to Joseph M. Steiner and O. H. Griest, who have assisted the Survey in establishing stations and supplying voluntary readings at Cataract and Shoals, Ind.

Kentucky.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K. Clapp.

Mississippi.—District hydrographer, M. R. Hall, assisted by W. E. Hall.

New York.—District hydrographer, R. E. Horton,[c] assisted by C. C. Covert.

North Carolina.—District hydrographer, M. R. Hall, assisted by W. E. Hall, B. S. Drane, and O. P. Hall. Dr. C. A. Schenck, director of the Biltmore School of Forestry, paid the gage readers at Davidsons River, Sitton, and Pinkbed.

Ohio.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K. Clapp. Acknowledgment should also be made to the Baltimore and Ohio Railroad for passes issued to F. W. Hanna and R. W. Pratt.

Pennsylvania.—District hydrographer, N. C. Grover, assisted by members of the computing section.

Tennessee.—District hydrographer, M. R. Hall, assisted by W. E. Hall, B. S. Drane, and O. P. Hall. Gage heights for stations at Nashville, Chattanooga, Knoxville, Rogersville, Bluff City, and McGhee were furnished by the following United States Weather Bureau officials: H. C. Bate, L. H. Pindell, and Levi A. Judkins.

Virginia.—District hydrographer, N. C. Grover, assisted by members of the computing section.

West Virginia.—District hydrographer, N. C. Grover, assisted by members of the computing section.

OHIO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Ohio River, which is formed by the junction of Allegheny and Monongahela rivers at Pittsburg, flows in a southwesterly direction, forming the boundaries between and draining the States of Ohio, Indiana, and Illinois on the north and West Virginia and Kentucky on the south. Its tributaries also drain portions of New York, Pennsylvania, Maryland, Virginia, North Carolina, Georgia, Alabama, and Mississippi.

The length of the stream, as surveyed by the United States Army engineers, from Pittsburg to Cairo is 967 miles.[d]

The river presents an interesting series of shoals and riffles, separated by pools in which the water is deeper and the fall very low. The summary of the profile made by the army engineers shows 187 pools with over 7 feet depth at low water. These occupy 632.5 miles and have an average length of 3.47 miles. Of these, 127 pools above Louisville, Ky., average 2.8 miles, with a total length of 363 miles; and 60 pools below Louisville, with a total length of 266 miles, have an average length of 4.4 miles.

On the borders of Ohio the riffles (103 in number) cover a combined length of 137 miles and have a total fall of 170 feet. The pools, with a combined length of 309 miles, have a fall of 64 feet, or but 2.5 inches per mile. The greatest fall noted for a single mile on the border of this State is at Letart Falls, Meigs County, where a descent of 3.2 feet is made. There are 11 riffles, with a descent exceeding 2 feet per mile. The least fall reported is in

[a] Office of the district hydrographer for southern Atlantic States and eastern Gulf of Mexico, 409 Temple court, Atlanta, Ga.

[b] Office of the district hydrographer for Mississippi Valley, 876–877 Federal Building, Chicago, Ill.

[c] Office of the district hydrographer for New York and Michigan (Lower Peninsula), 75 Arcade, Utica, N. Y.

[d] Ex. Doc. No. 72, House of Representatives, Forty-first Congress, third session, January, 1871, pp. 139–153.

a pool 8 to 15 miles below Cincinnati. This pool, with a length of 7 miles, has a fall of but 3.5 inches. Another pool with about as low a fall is found 23 to 30 miles above Cincinnati. These are the most conspicuous pools in this section of the Ohio.

On the borders of Indiana there are 55 riffles aside from the Louisville rapids. These show a total fall of 80.28 feet in a combined distance of 134.5 miles. At the Louisville rapids there is a fall of 23.09 feet in 2.25 miles. There is left but 18.13 feet for the fall of the stream in about 215 miles embraced in the pools, or only 1 inch per mile.

In general the rock floor of the valley is 30 to 50 feet below the level of the stream at low water. It rarely reaches a lower level than 75 feet below the stream. Its level is 65 or 75 feet below the stream between Evansville, Ind., and Shawneetown, Ill. It is thought that no place occurs in the whole length of the valley where a rock barrier crosses its entire width at a level as high as the bed of the present stream. In several places rock shelves extend out part way across the river bed, leaving a channel deep enough for the passage of boats along the opposite bank. At Letart Falls the rock is stated to extend across the entire breadth of the stream, but it dips toward the east bank sufficiently to allow the passage of boats when the rock of the western part of the stream bed is above the water surface. Well data indicate that this descent continues eastward beneath the bottom lands to a level as low as in the neighboring parts of the channel. Near Ravenswood, W. Va., rocky reefs are exposed at low water fully halfway across the stream bed, but wells on the bottom lands near the village show the rock floor to be at least 25 feet below the stream at low water. At Louisville it is found by wells and bridge soundings that a channel 25 feet or more lower than the present surface at the head of the rapids leads southwestward from near the south end of the Jeffersonville bridge a short distance and then turns westward, passing through the midst of the city.[a] Thus at the side of each of the three most conspicuous rock reefs touched by the stream a buried channel apparently occurs.

Notwithstanding the great number of riffles and shoals, the Ohio is generally navigable throughout the entire season for small boats drawing less than 3 feet of water. It is navigable for vessels drawing 6 feet of water during a few months of the early part of the season, but there is usually little traffic with such boats after the month of July. The canal at Louisville affords opportunity for passing around the rapids during low water. During high-water stages the boats are able to pass over the rapids.

The valley of Ohio River along the southern boundary of Ohio and Indiana is very narrow except for a few miles near Louisville, where it has expanded itself in the Devonian shales, and for a similar widening in the southwestern portion of Indiana, in the Coal Measures. Its narrowness has been a subject of remark from the early days of settlement. There are very few places between Pittsburg and Louisville where its width exceeds 2 miles, and usually it is scarcely more than 1 mile wide. In the vicinity of Louisville, where it crosses the low tract formed in the Devonian shales, it has a width of perhaps 4 miles, but on entering the Knobstone escarpment below the mouth of Salt River it narrows abruptly to a width of about 1 mile, and remains narrow for nearly 100 miles in its passage through the hard beds of Lower Carboniferous age. It then enters the Coal Measures and soon attains a width of 6 or 8 miles, which it maintains for much of its course to Cairo. The only exception is found at the point where it passes the elevated ridge below Shawneetown. Here its width is reduced to about 2½ miles. The depth of the valley ranges from about 600 feet down to scarcely 100 feet, being greatest on the border of the "panhandle" of West Virginia and least in the lower portion of its course. Its depth seldom falls below 300 feet in the portion above Louisville, and probably averages 450 feet. The narrow portion below Louisville is about 300 feet in depth. The broad portions at Louisville and in the lower parts of its course are but 100 to 150 feet in depth. The work done by the river in excavating a narrow valley through the elevated districts is apparently commensurate with that accomplished in eroding a wide valley in the low districts.

[a] Data on this subject were furnished by Maj. William J. Davis, of the Louisville school board, and by Messrs. John Ryan and John C. Oestrich, of the Louisville Pump Works.

The entire work of the stream, however, is less than should have been accomplished by a drainage line of this size in the time since the beginning of development of drainage lines. It is far less in proportion to its size than the work accomplished by the small tributaries which enter it from southern Indiana. The explanation of this meager amount of work is found in the enlargement of Ohio River in recent times. Investigations now in progress indicate that several independent drainage lines which formerly led northward from the Appalachian Mountains across southwestern New York, northwestern Pennsylvania, and Ohio into the Lake Erie basin have been united to form the present Ohio. The full extent of these changes is not yet determined, nor are all of the outlets for the old river systems satisfactorily traced; but enough is known to justify the statement that the small size of the valley of the Ohio is attributable to the recent union of the several independent drainage systems.

OHIO RIVER AT WHEELING, W. VA.

The United States Weather Bureau has made observations of the stage of Ohio River at Wheeling, W. Va., since 1882. In 1905 measurements of the flow were begun by the United States Geological Survey.

A large island divides the river at this point into two channels. This island is almost entirely overflowed during extreme floods. The right channel is straight above and below the station. The current is sluggish for gage heights from 6 to 8 feet. Below 5 feet the velocity is zero, owing to a low rock dam 3,444 feet below the measuring section. In high and medium stages the dam is submerged. The right bank is high, clean, and does not overflow. The left bank overflows in extreme high water. The bed of the stream is rocky and sandy, and is permanent. There is but one channel, broken by the piers of the bridge.

The left channel is straight above and below the station. The current is swift. The left bank is high, clean, and does not overflow. The right bank overflows in extreme high water. The bed of the stream is composed of gravel, and is permanent. There is but one channel, broken by two piers.

Discharge measurements in the left channel are made from the downstream side of a steel trolley and highway bridge about 100 feet above the water surface. An extra length of cable and 30 pounds of lead for use in making measurements at this point are stored in the basement of the upstream tollhouse on the Wheeling side.

Discharge measurements in the right channel are made from the downstream side of a steel trolley and highway bridge 50 feet above the water surface.

The "Government" gage, from which continuous records are furnished by the United States Weather Bureau, consists of sandstone blocks set in the riprap of the left bank of the left channel about 150 feet below the Pennsylvania depot. One foot vertical equals 5 feet on the incline.

In order to compare the relative heights of the water surface in the two channels, the United States Geological Survey installed a standard chain gage in the right channel June 1, 1905. It is bolted to the outside of the upstream hand rail in the second span from the Ohio side of the bridge, from which discharge measurements are made; length of chain, 58.46 feet. The datum of the two gages is the same. This gage is but temporary, and during 1905 was read twice each day.

The bench mark for the Weather Bureau gage is the high-water mark of February 7, 1884, cut in the stone bottom of the ogee on top of the water table on the southwest corner of the custom-house, corner of Sixteenth and Market streets; elevation, 53.1 feet above the zero of the gage. On June 1, 1905, the elevations of the foot marks of this gage were obtained, the 6.00 mark being assumed to be correct. Thus each foot mark in the stone flagging gage is a bench mark. Elevations below 5.00 feet were not determined.

Bench marks were established for the chain gage as follows: (1) The highest point on the corner of the upstream side of the right abutment of the bridge over the right channel, marked by black paint; elevation, 52.60 feet; (2) the southeast corner of the southwest stone support of the crossing watchman's tower, about 100 feet beyond the west end of the bridge; elevation, 48.96 feet. Elevations refer to the datum of both gages, which is 610.29 feet above sea level.

Discharge measurements of Ohio River at Wheeling, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
Prior to 1893 [a]					8.50	36,260
1892.						
October 10-13 [b]		[c] 642	[c] 3,472	[c] 0.88	1.10	3,050
1905.						
March 14	E. C. Murphy	1,362	19,920	4.10	14.35	81,740
March 14	do	1,352	19,300	4.01	13.94	77,440
March 15	do	1,326	17,410	3.80	12.37	66,280
March 17	do	1,285	15,040	3.45	10.43	51,850
March 20	do	1,457	38,890	5.89	28.20	229,200
March 20	do	1,461	42,750	6.13	30.80	261,900
March 21	do	1,489	54,780	6.23	38.90	341,100
March 21	do	1,489	57,360	6.18	40.70	354,400
March 22	do	1,486	59,580	6.07	42.05	361,600
March 22	do	1,486	60,510	6.05	42.50	365,700
March 23	do	1,488	58,830	5.73	41.60	336,900
March 23	do	1,486	56,790	5.60	40.30	318,100
March 24	do	1,482	49,250	5.20	35.20	255,800
March 24	do	1,482	45,550	4.99	32.70	227,300
March 25	do	1,457	37,560	4.95	27.20	186,100
March 25	do	1,457	35,050	4.80	25.50	168,100
March 27	do	1,452	30,830	4.83	22.44	149,100
April 13	A. H. Horton	1,344	18,700	3.65	13.06	68,380
April 19	do	1,259	11,710	2.46	7.51	28,760
April 21	do	1,266	11,490	2.44	7.35	27,990
June 1	R. H. Bolster	1,192	9,054	1.62	5.20	14,640
August 25	E. C. Murphy	1,201	9,799	1.84	5.78	18,040
August 28	do	1,231	12,310	2.56	7.78	31,500
November 1	do	1,212	10,270	1.93	6.20	19,800

[a] From Weather Bureau Report.
[b] Computed from three measurements at Davis Island Dam, Pa., and two measurements at Marietta, Ohio, made by army engineers in October, 1892.
[c] Left channel (Wheeling side) only.

Daily gage height, in feet, of Ohio River at Wheeling, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.6	4.4	17.7	14.0	8.8	5.3	6.6	13.4	4.9	2.9	6.5	22.6
2	9.4	4.4	17.7	12.4	8.2	5.0	6.0	11.4	4.5	2.8	6.2	20.9
3	8.8	5.9	16.7	10.9	7.5	5.6	5.9	8.9	4.0	2.8	6.2	19.[illegible]
4	8.0	6.8	15.3	9.8	6.8	6.6	6.0	7.3	3.7	3.0	6.6	29.[illegible]
5	8.5	7.6	14.3	8.9	6.5	5.9	6.6	6.1	3.1	3.3	6.5	30.[illegible]
6	8.8	7.6	14.0	8.2	6.2	5.3	6.9	5.6	3.4	4.0	6.1	23.9
7	7.5	6.9	14.4	7.6	6.0	5.0	7.9	5.2	3.3	4.6	6.2	17.[illegible]
8	6.8	6.9	13.4	7.9	7.0	7.6	8.8	4.9	3.1	3.9	6.7	13.7
9	6.1	6.9	17.9	7.9	6.9	9.4	9.5	4.5	2.9	3.4	7.9	11.6
10	6.0	8.9	25.7	8.5	6.9	9.0	9.9	4.6	2.9	3.0	8.6	10.6
11	6.0	9.1	27.7	8,9	7.0	8.0	8.4	4.8	2.8	2.9	8.7	9.9
12	5.9	17.6	26.3	11.6	7.8	8.3	7.7	4.6	3.4	2.9	8.0	9.3
13	6.9	14.7	20.3	13.1	9.0	8.3	7.9	4.7	10.7	3.1	7.9	8.3
14	17.3	15.3	14.9	11.9	13.5	8.8	8.3	5.0	10.3	4.1	7.3	7.9
15	17.4	15.3	13.0	10.6	12.6	7.9	9.6	6.1	8.7	5.9	6.9	7.3
16	13.7	15.1	11.3	8.4	14.2	7.3	9.9	8.1	7.1	6.1	6.6	6.9
17	11.3	14.3	10.5	8.1	14.4	7.1	8.6	11.4	6.2	6.2	6.6	6.3
18	9.3	.....	10.9	7.9	12.1	7.9	6.9	11.3	6.1	5.7	6.6	6.0
19	8.0	.....	14.9	7.6	10.5	7.9	6.9	9.3	6.0	5.1	6.4	5.9
20	7.3	[a] 10.3	28.2	7.3	9.2	9.5	6.0	7.9	5.7	6.8	6.6	5.9
21	7.2	.....	39.7	7.3	8.4	9.5	6.1	6.5	5.7	9.0	6.4	6.6
22	7.2	[a] 11.8	[b] 42.3	8.9	7.9	10.9	9.0	5.7	6.5	15.9	6.1	8.6
23	7.0	.....	41.8	11.8	7.0	13.7	8.0	5.5	5.9	13.1	5.9	13.6
24	6.6	.....	34.0	14.3	6.6	16.3	6.6	5.2	5.1	10.5	5.5	15.9
25	6.5	[a] 10.5	26.2	13.4	6.0	14.3	5.9	5.9	4.7	9.0	5.1	15.3
26	6.0	13.8	23.2	11.5	5.9	12.3	6.8	6.1	4.2	8.6	5.0	13.6
27	5.2	15.4	22.6	9.9	5.4	11.0	6.6	7.1	3.8	8.1	5.0	11.3
28	5.0	16.6	21.2	9.1	4.9	9.6	5.0	8.1	3.4	8.2	5.0	10.3
39	3.9	.....	19.9	9.4	5.1	9.0	5.0	6.9	3.1	8.5	6.0	9.3
30	3.1	.....	17.9	9.7	5.2	7.9	4.3	5.7	2.9	7.9	12.6	9.6
31	3.9	.....	15.9	.....	5.6	.....	5.8	5.0	.....	6.9	.....	13.6

[a] Estimated; river frozen February 18–25; gage heights, March 20–26, are means of four or five readings per day as taken by a hydrographer of the Survey.
[b] Crest of flood, 42.7.

NOTE.—These gage heights refer to Weather Bureau gage.

Station rating table for Ohio River at Wheeling, W. Va., from May 1, 1882, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	2,890	4.60	12,330	8.40	35,500	16.50	98,700
1.10	3,050	4.70	12,710	8.60	37,000	17.00	102,830
1.20	3,220	4.80	13,100	8.80	38,500	17.50	107,000
1.30	3,390	4.90	13,500	9.00	40,000	18.00	111,200
1.40	3,570	5.00	13,900	9.20	41,500	18.50	115,450
1.50	3,750	5.10	14,310	9.40	43,000	19.00	119,700
1.60	3,940	5.20	14,740	9.60	44,500	19.50	124,000
1.70	4,140	5.30	15,190	9.80	46,000	20.00	128,330
1.80	4,340	5.40	15,660	10.00	47,500	20.50	132,700
1.90	4,550	5.50	16,150	10.20	49,020	21.00	137,100
2.00	4,760	5.60	16,650	10.40	50,540	21.50	141,550
2.10	4,980	5.70	17,170	10.60	52,060	22.00	146,040
2.20	5,200	5.80	17,700	10.80	53,580	22.50	150,570
2.30	5,430	5.90	18,250	11.00	55,100	23.00	155,140
2.40	5,660	6.00	18,810	11.20	56,640	23.50	159,760
2.50	5,900	6.10	19,390	11.40	58,180	24.00	164,440
2.60	6,150	6.20	19,990	11.60	59,720	24.50	169,150
2.70	6,400	6.30	20,600	11.80	61,260	25.00	173,900
2.80	6,660	6.40	21,230	12.00	62,800	26.00	183,530
2.90	6,930	6.50	21,870	12.20	64,360	27.00	193,300
3.00	7,200	6.60	22,520	12.40	65,920	28.00	203,230
3.10	7,480	6.70	23,180	12.60	67,480	29.00	213,300
3.20	7,760	6.80	23,850	12.80	69,040	30.00	223,500
3.30	8,050	6.90	24,530	13.00	70,600	31.00	233,830
3.40	8,340	7.00	25,220	13.20	72,180	32.00	244,300
3.50	8,640	7.10	25,920	13.40	73,760	33.00	254,900
3.60	8,940	7.20	26,630	13.60	75,340	34.00	265,630
3.70	9,250	7.30	27,350	13.80	76,920	35.00	276,500
3.80	9,570	7.40	28,080	14.00	78,500	36.00	287,500
3.90	9,890	7.50	28,810	14.20	80,100	37.00	298,600
4.00	10,220	7.60	29,540	14.40	81,700	38.00	309,830
4.10	10,560	7.70	30,280	14.60	83,300	39.00	321,200
4.20	10,900	7.80	31,020	14.80	84,900	40.00	332,700
4.30	11,250	7.90	31,760	15.00	86,500	41.00	344,300
4.40	11,600	8.00	32,500	15.50	90,550	42.00	356,030
4.50	11,960	8.20	34,000	16.00	94,600	43.00	367,900

NOTE.—The above table is applicable only for open-channel conditions. It is based on 24 discharge measurements made during 1905, one prior to 1893, and one low-water measurement computed from five measurements made by the United States Army engineers above and below Wheeling in 1892.

It is well defined above gage height 5 feet. Below 5 feet it is based on one measurement at 1.1 feet, computed from the army engineers' measurements, and the extension of the area and velocity curves, and can be considered accurate within a few per cent.

Estimated monthly discharge of Ohio River at Wheeling, W. Va., for 1905.

[Drainage area, 23,820 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	106,200	7,480	33,480	1.41	1.63
February 1-17, 26-28	107,800	11,600	54,110	2.27	1.69
March	359,600	51,300	142,400	5.98	6.89
April	80,900	27,350	46,880	1.97	2.20
May	81,700	13,500	33,660	1.41	1.63
June	97,060	13,900	38,320	1.61	1.80
July	46,750	11,250	27,430	1.15	1.33
August	73,760	11,960	25,930	1.09	1.26
September	52,820	6,660	15,810	.664	.741
October	93,790	6,660	23,280	.977	1.13
November	67,480	13,900	24,000	1.01	1.13
December	229,700	18,250	72,740	3.05	3.52

MISCELLANEOUS MEASUREMENT.

The following discharge measurement was made on Hocking River near Logan, Ohio:

Discharge measurement of Hocking River near Logan, Ohio.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 30	R. W. Pratt	34	23.3	2.36	(a)	54.9

a Water 0.3 feet below northwest upper corner of large flat stone 100 yards below bridge.

ALLEGHENY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Allegheny River, which, with the Monongahela, forms the Ohio at Pittsburg, rises in northern Pennsylvania, flows north into the State of New York, then flows south through western Pennsylvania. The headwaters have an elevation of about 2,500 feet and join those of Genesee River on the north and of the Susquehanna on the east. The total length from the source to the mouth at Pittsburg is about 300 miles, 47 of which are in the State of New York. The principal facts concerning this river have been given in a report by George Lehman, assistant engineer, contained in House Document No. 72, Fifty-fifth Congress, third session. Although this river drains a large area, much of which is of an elevated and even mountainous character, yet it is of comparatively small value for water power. The total fall in 255 miles between Olean, N. Y., and the mouth is only 725 feet, or an average of less than 3 feet per mile. This descent is accomplished without abrupt pitches, and even with few rapids having a fall of much consequence. The drainage basin of Allegheny River above Redhouse is comparatively rugged and precipitous. It is mostly covered with brush and light forest. A considerable amount of snow accumulates in the winter and feeds the stream until late in spring. The basin is underlain by shales of the Chemung series, and the depth of soil is usually small, excepting in stream valleys. There are no lakes and no artificial storage tributary to the stream. The Cuba reservoir, which feeds the Erie Canal through Genesee River, lies on the divide between the Allegheny and Genesee drainage basins. A part of the overflow from this reservoir passes into the Allegheny, the rest passes into Genesee River. During about half of the year the river is navigable for small steamers to Franklin, 123 miles above Pittsburg.

The drainage areas of the river and its chief tributaries are given in the following table:

Drainage areas of Allegheny River and tributaries.

Stream.	Locality.	Drainage area.
		Sq. miles.
Allegheny River	Mouth	11,100
Do	Kittanning	8,688
Do	Above mouth of French Creek	5,950
Do	Franklin	5,670
Do	Warren	3,050
Do	Salamanca	1,560
Do	Olean, below Olean Creek	1,100
Do	Port Allegheny	220
Conewango Creek	Mouth	935
Tionesta Creek	do	458
French Creek	do	1,180
Clarion River	do	1,175
Redbank Creek	do	526
Mahoning Creek	do	397
Kiskiminitas River	do	1,846
Do	Salina	1,770
Blacklick Creek	Blacklick	403

ALLEGHENY RIVER AT REDHOUSE, N. Y.

This station was established September 4, 1903, by R. E. Horton. It is located at the Redhouse Bridge, near the stations of the Erie and Pennsylvania railroads and about 5 miles below Salamanca, N. Y., about 13 miles above the point where the river leaves New York State. At Olean, N. Y., the wasteway from the Cuba reservoir enters the stream through Olean Creek. This reservoir is located on the divide between Oil Creek, tributary to Allegheny River, and Genesee River. The storage is commonly turned into Genesee River through the abandoned summit level of Genesee Valley Canal, but may be diverted into Oil Creek through the guard lock at the head of the canal.

The discharge measurements from which the accompanying rating table has been prepared were mostly made during the gradual decline of the stream after the culmination of the spring freshet of 1905. The stage of the stream remained constant or fell slightly during each measurement, so that the rating table represents the discharge for conditions when the stream is statical or falling slightly.

The channel is straight for 800 feet above and below the station, 494 feet wide between abutments, broken by two piers. The current velocity is well distributed. The right bank is high and does not overflow. The left bank overflows only at flood stages. At extreme high water there is an additional flood channel on the left bank. The bed is of gravel and is regular.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the left end of the downstream side of the bridge.

A standard chain gage is fastened to the upstream side of the bridge near the middle of the left span; length of chain, 24.16 feet. The gage is read twice each day by G. H. Smith. The bench mark is a circle cut on the downstream side of the left abutment; elevation, 21.09 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 240–241; 128, pp 45–46.
Discharge: 98, p 241; 128, p 46.
Gage heights: 98, p. 241; 128, p 46.

Discharge measurements of Allegheny River at Redhouse, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 25	W. B. Freeman	368	3,313	5.88	9.63	19,470
March 27	do	368	3,412	6.25	9.91	21,320
March 28	do	368	3,385	6.07	9.88	20,570
March 28	do	368	3,353	6.01	9.77	20,160
March 29	do	368	3,168	5.65	9.34	17,930
March 30	do	368	3,007	5.33	8.88	16,040
March 31	do	368	2,764	4.73	8.24	13,060
April 1	do	368	2,489	4.09	7.44	10,170
April 1	do	368	2,415	3.89	7.24	9,386
April 2	do	368	2,286	3.51	6.77	8,029
April 3	do	368	2,045	2.94	6.11	6,015
April 3	do	363	2,003	2.84	5.98	5,681
April 4	do	363	1,867	2.40	5.58	4,484
April 5	do	363	1,797	2.32	5.41	4,161
July 31	Murphy and Covert	362	1,214	0.93	3.74	1,135
August 26	C. C. Covert	357	993	0.45	3.05	446

Daily gage height, in feet, of Allegheny River at Redhouse, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.52	4.5	4.43	7.35	4.45	3.48	3.95	3.81	2.95	2.8	3.85	7.0
2	5.76	4.85	4.43	6.45	4.3	3.4	4.02	3.58	2.95	2.8	4.1	5.1
3	5.86	4.95	4.43	6.0	4.25	3.3	4.08	3.44	2.92	2.9	4.0	6.55
4	4.46	4.75	4.43	5.55	4.18	3.3	4.05	3.31	2.9	3.0	4.0	7.15
5	5.16	4.74	4.43	5.35	4.0	3.3	4.6	3.14	2.9	3.12	4.0	6.65
6	5.16	4.69	4.43	5.18	4.0	3.45	5.0	3.11	3.0	3.15	4.8	6.3
7	4.91	4.54	4.43	5.0	4.25	5.2	5.4	3.26	3.0	3.1	5.0	5.85
8	.....	4.54	4.43	4.85	4.35	5.25	5.85	3.38	3.0	2.88	5.0	5.5
9	4.34	4.54	4.58	4.6	4.18	4.85	5.3	3.36	2.9	2.8	5.2	5.25
10	4.21	4.52	4.83	4.55	4.0	4.35	4.45	3.31	2.85	2.72	5.2	5.05
11	4.26	4.44	5.02	4.5	3.9	4.45	4.45	3.26	2.95	2.75	4.6	4.85
12	4.26	4.44	5.22	4.65	3.8	4.7	4.85	3.48	3.7	3.5	4.6	4.75
13	5.06	4.44	5.17	4.9	3.8	4.5	5.1	3.46	3.72	4.5	4.5	4.55
14	5.46	4.44	4.92	4.7	3.8	4.3	5.25	3.61	3.58	4.25	4.38	4.35
15	5.01	4.39	4.92	4.6	3.8	4.02	5.2	3.56	3.35	3.95	4.3	4.15
16	4.81	4.39	4.92	4.6	3.72	3.92	4.6	3.54	3.3	3.75	4.3	3.85
17	4.71	4.39	4.92	4.5	3.7	4.4	4.25	3.46	3.3	3.55	4.2	3.5
18	4.64	4.39	6.52	4.5	3.7	5.25	4.05	3.38	3.5	3.4	4.2	3.6
19	4.5	4.36	11.42	4.55	3.68	5.5	3.98	3.28	3.3	4.05	4.0	3.85
20	4.37	4.34	11.57	4.85	3.6	5.3	3.82	3.21	3.2	4.6	4.0	3.55
21	4.27	4.34	11.67	7.0	3.6	5.6	3.68	3.16	3.2	4.9	3.7	4.1
22	4.23	4.33	11.12	7.65	3.55	7.18	3.56	3.14	3.12	5.0	3.45	6.4
23	4.15	4.33	9.94	6.4	3.5	6.9	3.38	3.06	3.02	5.0	3.45	6.2
24	4.1	4.33	9.64	5.65	3.48	6.3	3.26	3.01	3.0	4.85	3.45	5.75
25	3.85	4.33	9.64	5.35	3.4	5.6	3.51	2.96	2.92	4.6	3.65	5.55
26	3.4	4.33	9.7	5.12	3.4	5.15	3.51	2.98	2.9	4.35	3.35	5.15
27	3.35	4.33	9.92	4.9	3.4	4.85	3.31	3.0	2.9	4.15	3.4	4.85
28	4.1	4.41	9.76	4.7	3.58	4.45	3.26	2.98	2.85	3.95	3.45	4.65
29	4.2	.....	9.3	4.6	3.5	4.25	3.88	2.95	2.8	3.75	6.4	6.0
30	4.4	.....	8.8	4.6	3.5	4.05	4.16	2.95	2.8	3.62	7.3	7.5
31	4.45	.....	8.15	.....	3.5	.....	3.94	2.95	.....	3.6	.....	6.65

NOTE.—River frozen entirely across from January 1 to March 18, with the exception of a narrow channel near one bank, which appeared February 25 and lasted during the remainder of ice period. During frozen period gage was read to surface of ice. Thickness varied from 0.6 to 0.95 feet.

Station rating table for Allegheny River at Redhouse, N. Y., from September 4, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	195	4.40	2,043	6.10	5,950	8.40	13,960
2.80	260	4.50	2,200	6.20	6,245	8.60	14,800
2.90	328	4.60	2,365	6.30	6,545	8.80	15,660
3.00	400	4.70	2,540	6.40	6,845	9.00	16,540
3.10	478	4.80	2,725	6.50	7,150	9.20	17,420
3.20	564	4.90	2,920	6.60	7,460	9.40	18,300
3.30	658	5.00	3,130	6.70	7,770	9.60	19,220
3.40	759	5.10	3,350	6.80	8,090	9.80	20,140
3.50	866	5.20	3,580	6.90	8,410	10.00	21,100
3.60	978	5.30	3,820	7.00	8,740	10.20	22,100
3.70	1,095	5.40	4,065	7.20	9,400	10.40	23,100
3.80	1,216	5.50	4,315	7.40	10,080	10.60	24,100
3.90	1,341	5.60	4,570	7.60	10,790	10.80	25,100
4.00	1,471	5.70	4,830	7.80	11,530	11.00	26,200
4.10	1,605	5.80	5,100	8.00	12,300	11.50	28,950
4.20	1,745	5.90	5,375	8.20	13,120	12.00	31,800
4.30	1,891	6.00	5,660				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 19 discharge measurements made during 1903–1905. It is very well defined between gage heights 3.1 feet and 10 feet.

Estimated monthly discharge of Allegheny River at Redhouse, N. Y., for 1903–1905.

[Drainage area, 1,643 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September 4–30	3,130	708	1,462	0.890	0.894
October	8,905	708	2,262	1.38	1.59
November	12,105	978	2,918	1.78	1.99
December 1–25	1,818	866	1,337	.814	.757
1904.					
March 16–31	26,750	2,365	10,690	6.51	3.87
April	13,750	2,764	6,945	4.23	4.72
May	10,430	1,341	3,927	2.39	2.76
June	9,808	564	2,134	1.30	1.45
July	5,805	611	1,557	.948	1.09
August	2,043	400	797	.485	.559
September	2,632	400	914	.556	.620
October	3,350	1,072	1,985	1.21	1.40
November 1–27	1,341	611	839	.511	.513
December 27–31	12,500	4,190	7,430	4.52	.840
1905.					
March 19–31	29,885	12,910	21,620	13.20	6.38
April	10,980	2,200	3,734	2.27	2.53
May	2,122	759	1,241	.755	.870
June	9,334	658	2,905	1.77	1.98
July	5,238	620	1,992	1.21	1.40
August	1,228	364	640	.390	.450
September	1,119	260	496	.302	.337
October	3,130	208	1,269	.772	.890
November	9,740	708	2,201	1.34	1.50
December	10,430	866	4,275	2.60	3.00

NOTE.—No estimates for frozen period.

ALLEGHENY RIVER AT KITTANNING, PA.

This station, which is located at Market Street Bridge, was established August 18, 1904, by R. J. Taylor.

The channel, which is broken by four piers at the station, is straight for about 500 feet above and 1,000 feet below. The current is swift. Both banks are high, clean, and do not overflow. The bed of the stream is composed of clean gravel and is permanent. The water is approximately 3 to 4 feet deep in the first three channels and 6 to 8 feet deep in the last two at low stages.

Discharge measurements are made from the downstream foot walk of the five-span steel highway bridge. The initial point for soundings is the left end of the hand rail on the downstream side of the bridge.

A standard chain gage, which is read twice each day by S. B. Cochrane, is bolted to the outside of the upstream hand rail in the first span from the left bank; length of chain, 38.67 feet. The bench mark is the west corner of the top course of stones of the left abutment; elevation, 33.83 feet above gage datum.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, page 47.

Discharge measurements of Allegheny River at Kittanning, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Remarks.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*	
March 18	Grover and Morse	869	10,480	4.11	12.00	43,090	Floats and meter.
March 18	do	869	10,340	4.27	11.85	44,150	Floats.
March 19	N. C. Grover	869	14,570	6.92	16.55	100,800	Do.
March 19	Grover and Morse	869	15,500	7.27	17.59	112,700	Do.
March 19	do	869	16,380	7.66	18.57	125,500	Do.
March 19	do	869	17,210	7.93	19.48	136,400	Do.
March 19	do	869	18,270	8.41	20.66	154,600	Do.
March 19	do	869	19,770	9.08	22.33	179,500	Do.
March 19	do	869	20,450	9.20	23.08	188,100	Do.
March 20	do	869	25,330	9.29	28.50	235,300	Do.
March 20	do	869	25,470	9.30	28.69	236,900	Do.
March 20	do	869	25,510	9.48	28.71	241,800	Do.
March 20	do	869	25,540	9.48	28.74	242,000	Do.
March 21	do	869	22,540	8.43	25.40	190,000	Floats and meter.
March 21	do	869	21,860	8.13	24.65	177,800	Floats.
March 21	do	869	21,440	8.28	24.18	177,500	
March 22	do	869	19,740	7.16	22.29	141,400	
March 22	do	869	19,200	7.20	21.69	138,400	
March 22	do	869	18,790	6.91	21.24	129,800	
March 23	do	869	17,000	6.57	19.25	111,700	
March 24	do	869	14,510	5.92	16.48	85,960	
March 25	do	869	14,110	5.94	16.04	83,840	
April 10	A. H. Horton	809	5,000	2.37	5.54	11,860	
April 11	do	860	6,106	2.94	6.83	17,970	
April 14	do	835	5,552	2.58	6.17	14,320	
April 20	do	791	4,919	2.24	5.45	11,040	
June 2	R. H. Bolster	680	3,597	1.45	3.73	5,222	
August 30	E. C. Murphy	666	3,442	1.39	3.53	4,794	
November 3	do	768	4,654	2.13	5.10	9,941	

Daily gage height, in feet, of Allegheny River at Kittanning, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.1	9.8	.....	10.5	5.3	3.8	4.4	7.65	3.1	3.3	4.7	12.8
2	7.4	9.6	.....	8.9	4.9	3.7	4.8	6.3	3.1	3.4	4.6	10.8
3	7.9	9.6	9.4	7.7	4.8	3.6	5.1	5.3	3.1	3.6	4.5	14.9
4	8.5	9.6	.....	7.3	4.5	3.4	5.4	4.7	3.1	5.0	5.0	14.8
5	7.4	.....	.....	7.0	4.2	3.3	6.8	4.3	2.8	4.3	5.1	12.2
6	6.3	.....	.....	6.8	.....	3.6	6.6	3.9	2.8	3.8	5.3	10.7
7	6.1	9.5	.....	6.4	.....	4.3	[illegible]	3.8	2.8	3.6	6.2	9.0
8	6.2	.....	11.6	5.9	.....	7.0	9.2	3.8	2.6	3.2	7.0	8.2
9	6.3	.....	.....	5.6	.....	6.8	7.7	3.8	2.5	2.8	8.0	7.7
10	6.4	9.0	.....	5.5	5.5	6.3	7.4	3.9	2.5	2.8	7.6	7.3
11	6.6	.....	.....	6.4	5.0	5.9	5.9	4.0	4.85	3.0	7.4	7.0
12	10.4	.....	.....	6.2	4.7	5.6	6.0	3.6	7.4	4.1	6.8	6.6
13	12.3	.....	.....	6.2	5.5	5.2	7.3	5.4	6.8	5.5	6.6	6.4
14	13.6	9.0	.....	5.8	6.5	5.2	8.1	6.2	5.5	5.3	6.5	6.0
15	15.4	.....	.....	5.5	6.9	4.7	8.6	5.8	5.0	5.5	6.3	5.8
16	16.1	.....	.....	5.4	7.1	4.5	8.1	6.0	4.7	5.4	6.1	5.2
17	16.1	8.7	.....	5.3	7.2	4.5	7.6	6.5	4.5	5.25	5.9	4.7
18	14.6	.....	13.0	5.3	6.7	5.0	7.0	5.6	4.5	4.8	5.8	4.5
19	14.4	.....	18.2	5.1	6.3	6.1	6.4	4.8	4.5	5.6	5.6	4.4
20	14.4	.....	28.2	5.3	5.6	7.4	6.1	4.2	4.6	6.2	5.5	4.3
21	14.4	8.4	24.8	6.9	5.1	8.3	5.8	4.2	4.5	9.5	5.2	5.6
22	13.8	.....	21.8	9.2	4.7	10.0	5.4	4.5	4.4	8.2	4.8	7.8
23	13.1	.....	18.4	10.6	4.5	9.6	4.2	4.8	4.1	7.4	4.7	9.7
24	12.3	8.1	16.5	9.4	4.2	9.3	3.8	5.2	3.7	7.3	4.6	9.6
25	11.4	.....	16.0	8.8	4.0	7.8	3.6	4.8	3.5	7.3	4.6	8.1
26	10.6	.....	15.8	7.2	3.9	6.7	3.5	4.6	3.2	6.7	4.5	7.2
27	10.1	.....	15.0	6.8	4.2	6.4	3.4	4.2	3.1	6.3	4.8	6.9
28	10.0	9.1	14.3	6.2	4.2	5.7	3.3	3.8	3.1	5.8	6.0	8.9
29	9.9	.....	13.7	5.9	4.4	5.0	3.1	3.6	3.1	5.3	9.2	9.9
30	9.9	.....	12.6	5.6	4.4	4.6	11.4	3.4	3.2	5.1	12.0	11.2
31	9.8	.....	11.8	.....	4.2	.....	10.6	3.2	.....	4.9	.....	11.3

NOTE.—Ice gorge January 12 to February 12 approximately. River frozen January 12 to March 18. The ice jam below Ford City broke on the morning of March 18. Readings during this period were to the top of the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 14	8.9	9.0	1.9
February 17	8.6	8.7	2.0
February 21	8.4	8.4	2.0
February 24	8.2	8.1	2.0
February 28	9.1	9.1	1.6
March 3	9.4	9.4	.....

The mean gage heights March 18-22 were recorded from several readings made each day by a hydrographer of the Survey. Maximum gage height March 20 was 28.80. The best available testimony is to the effect that this stage was higher than any since 1865, when the river was probably 6 to 8 inches higher. In the freshet of 1832 the stage was probably higher than in 1865.

Station rating table for Allegheny River at Kittanning, Pa., from August 18, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	1,740	4.30	7,065	6.60	16,470	11.50	43,850
2.10	1,840	4.40	7,400	6.70	16,950	12.00	47,150
2.20	1,960	4.50	7,740	6.80	17,430	12.50	50,630
2.30	2,095	4.60	8,085	6.90	17,920	13.00	54,280
2.40	2,245	4.70	8,435	7.00	18,410	13.50	58,120
2.50	2,410	4.80	8,795	7.20	19,390	14.00	62,110
2.60	2,590	4.90	9,165	7.40	20,400	14.50	66,200
2.70	2,785	5.00	9,545	7.60	21,420	15.00	70,410
2.80	2,990	5.10	9,930	7.80	22,470	16.00	79,220
2.90	3,205	5.20	10,320	8.00	23,540	17.00	88,620
3.00	3,430	5.30	10,720	8.20	24,620	18.00	98,620
3.10	3,665	5.40	11,130	8.40	25,700	19.00	109,150
3.20	3,910	5.50	11,550	8.60	26,800	20.00	120,330
3.30	4,165	5.60	11,970	8.80	27,910	21.00	132,210
3.40	4,425	5.70	12,400	9.00	29,030	22.00	144,710
3.50	4,690	5.80	12,830	9.20	30,150	23.00	157,920
3.60	4,960	5.90	13,270	9.40	31,280	24.00	171,720
3.70	5,235	6.00	13,720	9.60	32,420	25.00	185,720
3.80	5,515	6.10	14,170	9.80	33,570	26.00	199,950
3.90	5,805	6.20	14,620	10.00	34,730	27.00	214,360
4.00	6,105	6.30	15,080	10.50	37,660	28.00	229,030
4.10	6,415	6.40	15,540	11.00	40,700	29.00	243,900
4.20	6,735	6.50	16,000				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 24 discharge measurements made during 1904–1905. It is well defined between gage heights 2.25 feet and 29 feet. At the higher stages the rating curve was drawn through measurements made on the falling stage of the river in the 1905 spring flood.

Estimated monthly discharge of Allegheny River at Kittanning, Pa., for 1904–1905.

[Drainage area, 8,688 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 25–31	7,740	3,665	5,584	0.642	0.167
September	8,085	1,740	3,094	.356	.397
October	13,720	2,590	6,153	.708	.816
November	5,515	1,960	2,952	.340	.379
December 1–11, 24–31	49,920	2,095	13,870	1.60	1.13
1905.					
January 1–11	26,250	14,170	18,640	2.14	.876
March 18–31	232,000	45,810	97,670	11.24	5.85
April	38,260	9,930	18,020	2.07	2.31
May 1–5, 10–31	19,390	5,805	10,380	1.19	1.20
June	34,730	4,165	13,640	1.57	1.75
July	43,210	3,665	15,870	1.83	2.11
August	21,680	3,910	8,839	1.02	1.18
September	20,400	2,410	6,299	.725	.809
October	31,850	2,990	11,050	1.27	1.46
November	47,160	7,740	14,430	1.66	1.85
December	69,560	7,065	27,090	3.12	3.60

NOTE.—Ice conditions December 12–23, 1904, and January 12 to March 18, 1905; no estimates made. Discharge March 19, 1905, increased 20,320 second-feet to allow for increased discharge due to rising stage.

CHADAKOIN RIVER AT JAMESTOWN, N. Y.

Chadakoin River drains Lake Chautauqua, entering Allegheny River in Pennsylvania through Conewango Creek. Lake Chautauqua extends in a northwest-southeast direction. Its head is 8 miles from Lake Erie and its water surface is at an elevation of 1,308 feet above sea level, or 735 feet above Lake Erie. The drainage area above the foot of the lake is 190.6 square miles, of which 20.8 square miles comprise the lake surface, which represents 10.9 per cent of the drainage area. The land tributary to the lake is very rolling and the soil is impervious. Chadakoin River furnishes water power at numerous dams.

A gaging station was established on Chadakoin River April 3, 1904, by R. E. Horton, at the outlet of Lake Chautauqua, near Jamestown, N. Y. The gage was read once each day by R. L. Carlson. The station was discontinued March 18, 1905.

A description of the station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 48–49.

Daily gage height, in feet, of Chadakoin River at Jamestown, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	2.2	2.0	1.4	12	2.0	1.8	1.8	22	1.8	1.4	.....
2	2.1	2.0	1.4	13	2.0	1.8	1.8	23	2.0	1.5	.....
3	1.9	1.8	1.4	14	2.0	1.7	1.8	24	2.0	1.5	.....
4	1.8	1.8	1.4	15	1.9	1.7	1.8	25	1.9	1.5	.....
5	1.9	1.7	1.4	16	1.8	1.7	1.8	26	1.8	1.5	.....
6	2.1	1.7	1.4	17	1.8	1.8	1.8	27	1.8	1.5	.....
7	2.1	1.7	1.6	18	1.8	1.6	2.0	28	1.9	1.5	.....
8	2.0	1.7	1.6	19	1.8	1.6	.....	29	2.0	.....	.....
9	2.0	1.8	1.6	20	1.8	1.6	.....	30	2.0	.....	.....
10	1.8	1.8	1.8	21	1.8	1.4	.....	31	2.0	.....	.....
11	2.0	1.8	1.8								

KISKIMINITAS RIVER AT SALINA, PA.

This station was established August 17, 1904, by R. J. Taylor. It is located at the highway bridge between the village of Salina, Pa., and the Pennsylvania Railroad station, and is about 200 feet from the latter.

Both banks are high, rocky, clean, and are not subject to overflow. The bed of the stream is composed of rock and is clean and permanent.

Discharge measurements were made from the highway bridge until March, 1905, when the bridge was carried away by an ice freshet. For the remainder of the year gage heights were referred to temporary gage. The data will be published in the 1906 Progress Report. A new highway bridge will occupy a site about 500 feet below that of the old bridge. A chain gage will be attached to this as soon as it is completed. The stage of the river is read twice each day by J. F. Whitesell. Bench marks were established as follows: (1) A chisel draft on a shelf on the downstream corner of the right abutment; elevation, 5.77 feet. (2) A chisel draft on the top of the downstream corner of the right abutment; elevation, 30.39 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 49–50.

BLACKLICK CREEK AT BLACKLICK, PA.

This station was established August 16, 1904, by R. J. Taylor. It was located at the covered wooden highway bridge one-fourth mile from the railway station at Blacklick, Pa. During September, 1905, this bridge was torn down and replaced.

A standard chain gage was established November 9, 1905, on the new bridge, with its zero referred to the same datum as formerly; length of chain, 20.15 feet. While the new bridge was being erected, the stage of the river was observed on a staff gage reading to the datum of the original gage. The gage is read once each day by Mark Maynard. Bench marks were established as follows: (1) A nail in first maple tree from the door of Mr. Maynard's house, 1 foot above ground, driven horizontally and bent over 1 inch from head; elevation, 13.92 feet. (2) The heads of four spikes driven into the root of a large maple tree 45 feet from the edge of low water and about 190 feet upstream from the bridge; elevation, 12.96 feet. (3) Upper edge of horizontal cross plate at the elevation of the guard rail on the upstream side of the bridge, 4.3 feet from the initial point for soundings; elevation, 14.43 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 50–51.

Discharge measurements of Blacklick Creek at Blacklick, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 14	Grover and Morse	183	413	4.17	4.49	[a] 1,724
March 24	do	187	473	4.45	4.90	[a] 2,108
April 12	A. H. Horton	188	558	4.33	5.45	[a] 2,416
April 15	do	175	304	3.42	3.86	[a] 1,040
June 3	R. M. Packard	156	153	1.49	2.80	[a] 228
September 1	E. C. Murphy	140	104	1.23	2.36	[a] 128
September 1	L. O. Murphy	150	118	1.11	2.35	[a] 131
November 2	E. C. Murphy	199	543	.93	3.36	[b] 507

[a] Made from coal tipple. [b] Made from new bridge.

Daily height, in feet, of Blacklick Creek at Blacklick, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	.....	.....	3.4	3.0	3.1	3.1	4.1	2.4	2.2	3.6	6.4
2	3.8	.....	.....	3.3	2.9	3.0	3.1	3.7	2.3	2.2	3.3	7.0
3	4.1	.....	.....	3.2	2.9	2.8	2.9	3.3	2.3	2.3	3.2	10.7
4	3.8	.....	.....	3.0	2.8	2.7	2.8	3.0	2.4	2.2	3.3	6.5
5	3.6	.....	.....	3.2	2.8	2.7	3.8	3.1	2.3	2.2	3.2	5.1
6	3.5	.....	.....	3.4	2.9	2.7	3.3	2.8	2.2	2.2	3.7	4.6
7	3.2	.....	.....	3.5	3.5	5.9	3.1	3.0	2.2	2.2	3.7	4.0
8	3.0	2.9	7.6	3.4	3.4	4.6	4.2	3.1	2.1	2.1	3.6	3.9
9	3.3	.....	7.4	3.5	3.1	3.9	3.5	3.0	2.1	2.1	3.5	3.7
10	3.2	.....	6.5	3.5	2.9	3.5	3.1	2.8	2,1	2.0	3.3	3.6
11	3.1	.....	5.5	6.1	3.0	4.2	3.0	2.7	[a] 6.5	3.4	3.2	3.5
12	4.4	.....	5.1	5.3	4.1	4.4	2.9	2.8	4.7	4.0	3.1	3.4
13	5.4	.....	4.7	4.5	3.9	4.0	2.9	3.2	4.0	3.3	3.1	3.3
14	4.6	3.0	4.5	4.0	4.4	3.6	2.9	3.0	3.5	3.0	3.2	3.2
15	4.1	.....	4.4	4.0	4.6	3.3	2.8	3.9	3.2	2.9	3.1	3.2
16	3.8	3.0	4.5	3.6	4.0	3.1	2.6	3.6	3.2	2.9	3.2	3.2
17	3.6	.....	5.4	3.6	3.8	3.1	2.5	3.3	3.0	2.8	3.2	3.0
18	3.6	3.0	5.9	3.7	3.7	3.0	2.4	3.0	2.9	2.7	3.1	3.0
19	3.4	.....	8.4	3.5	3.5	3.7	2.5	2.8	2.8	3.7	3.0	3.0
20	3.5	.....	7.0	3.4	3.3	3.2	3.0	2.7	2.7	6.0	3.0	2.9
21	3.5	3.4	8.6	4.8	3.2	4.2	2.8	2.7	2.6	4.6	2.9	4.9
22	3.3	.....	7.0	5.3	3.0	5.8	2.9	2.6	2.5	4.1	2.8	4.5
23	3.2	.....	6.3	4.6	2.9	4.9	2.7	2.5	2.4	3.9	2.8	4.3
24	3.3	.....	5.0	4.2	2.9	4.4	3.1	2.4	2.4	3.7	2.8	4.1
25	3.0	.....	5.4	3.8	2.7	4.0	2.8	3.5	2.3	3.8	3.0	3.6
26	2.7	.....	5.5	3.6	2.7	3.7	2.6	3.0	2.3	4.0	2.9	3.7
27	3.0	.....	4.9	3.6	2.8	3.4	2.6	2.7	2.3	3.7	2.8	3.6
29	3.0	.....	4.5	3.4	2.6	3.2	2.5	2.6	2.3	3.5	2.9	3.7
29	3.0	.....	4.0	3.3	2.5	3.0	3.7	2.6	2.2	3.3	7.7	6.5
30	3.0	.....	4.0	3.2	2.6	2.9	4.3	2.5	2.2	3.1	7.0	5.1
31	.....	.....	3.6	....	3.1	.....	4.7	2.4	.....	3.1	.....	4.4

[a] Approximate.

NOTE.—River frozen entirely across for several miles up and down stream from January 31 to March 6. During this period the following comparative readings were made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 8	2.9	3.0	0.7
February 14	3.0	3.0	.8
February 16	3.0	3.0	.8
February 18	3.0	3.0	.8
February 21	3.4	3.4	.7

Station rating table for Blacklick Creek at Blacklick, Pa., from August 17, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	21	2.60	199	3.40	597	4.20	1,327
1.90	35	2.70	233	3.50	676	4.30	1,432
2.00	51	2.80	270	3.60	759	4.40	1,540
2.10	69	2.90	310	3.70	846	4.50	1,650
2.20	89	3.00	354	3.80	936	4.60	1,765
2.30	112	3.10	403	3.90	1,029	4.70	1,880
2.40	138	3.20	460	4.00	1,125	4.80	2,000
2.50	167	3.30	525	4.10	1,224	4.90	2,120

NOTE.—The above table is applicable only for open channel conditions. It is based on 10 discharge measurements made during 1904-5. It is not very well defined; above 5 feet the discharge is estimated.

Estimated monthly discharge of Blacklick Creek at Blacklick, Pa., for 1904-5.

[Drainage area, 403 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 17-31	167	35	88.3	0.219	0.122
September	100	32	52.2	.129	.144
October	216	28	92.8	.230	.265
November	112	35	63.1	.156	.174
December 1-6, 25-31	4,890	60	1,052	2.62	1.26
1905.					
January 1-30	2,765	233	757	1.88	2.10
March 8-31	7,310	759	3,245	8.05	7.18
April	3,730	354	1,042	2.58	2.88
May	1,765	167	547	1.36	1.57
June	3,450	233	938	2.33	2.60
July	1,880	138	466	1.16	1.34
August	1,224	138	393	.975	1.12
September	4,305	69	411	1.02	1.14
October	3,590	51	606	1.50	1.73
November	6,130	270	802	1.99	2.22
December	11,270	310	1,776	4.41	5.08

NOTE.—No estimates made during frozen period.

MONONGAHELA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Monongahela River is formed near Fairmont, Marion County, in the northern part of West Virginia, by the union of its West Fork with Tygarts Valley River. The headwaters of the latter stream lie on the slopes and in the valleys of the Appalachian Mountains near the eastern boundary of West Virginia, thence they flow northward, draining a hilly and mountainous country. West Fork has its headwaters west of those of Tygarts Valley River, in the central part of West Virginia, thence they flow northward, draining a hilly country.

The principal tributaries of Monongahela River below Fairmont are Cheat and Youghiogheny rivers, both entering from the east. Cheat River drains a rugged, mountainous district in northern West Virginia and flows into Monongahela River near Point Marion, Pa. Youghiogheny River drains a mountainous district of Maryland and Pennsylvania and enters the Monongahela about 15 miles above Pittsburg. The basins of all these tributary rivers have steep slopes and collect and discharge their waters quickly, with the result that the Monongahela is liable to the excessive freshets for which it is noted. The whole basin was once heavily timbered, but has been thoroughly cleared except about the upper waters of the principal streams. Little water power is used in the basin. Navigation extends to Fairmont.

MONONGAHELA RIVER AT LOCK NO. 4, PA.

This station was established in March, 1905, for the purpose of studying the flood discharge. It is located at the Government dam at Lock No. 4, Pa., and the bridge at Belle Vernon, Pa.

The channel is straight for 800 feet above and below the bridge. The velocity of the current is small, except at high stages. The right bank is high and does not overflow. The left bank is low, clean, and liable to overflow. The bed of the stream is composed of sand and gravel and is permanent. There are three channels at all stages, and no obstruction to the flow.

The discharge at high water is determined by computations of the flow over the crest of the dam, and that at low water by current-meter measurements from the bridge. The initial point for soundings at the bridge is the center of the hand-rail post over the left abutment on the downstream side.

There are two timber gages, graduated to feet and tenths, one at the head of the locks and the other below. The gages are the property of the army engineers, and daily gage readings are furnished by the United States Weather Bureau. The elevation of the zero of the upper gage is 726.112 feet above mean sea level; that of the lower gage is 717.816 feet, and that of the crest of the dam is 734.94 feet. The crest of the dam is at gage height 8.80 feet. Bench mark No. 1 is a cross cut on the lower horizontal piece of the hand rail of the bridge, upstream side, 162 feet from the initial point for soundings. Its elevation is 10.89 feet above bench mark No. 2, which is a quarter circle cut on the west corner of the left abutment, downstream side. These bench marks are not referred directly to the gage at Lock No. 4, 2 miles below. Bench mark No. 1 (which is referred to No. 2) is for the purpose of referring the water surface at the bridge, when measurement is made, to a permanent datum, in order that comparison may be made with other measurements at the bridge. In each case the gage height is taken from the lower gage at the lock.

Discharge measurements of Monongahela River at Lock No. 4, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 13	E. C. Murphy	866	12,210	1.76	13.6	21,520
March 18	do	843	10,780	.95	9.8	10,240
March 23	Grover and Morse	754	13,790	2.80	17.6	38,680

Station rating table for Monongahela River at Lock No. 4, Pa., from March 31, 1886, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
12.00	15,300	14.00	22,500	17.00	36,100	23.50	70,800
12.10	15,600	14.10	22,920	17.20	37,100	24.00	73,800
12.20	15,900	14.20	23,340	17.40	38,100	25.00	79,800
12.30	16,210	14.30	23,760	17.60	39,100	26.00	85,800
12.40	16,520	14.40	24,180	17.80	40,100	27.00	92,600
12.50	16,840	14.50	24,600	18.00	41,100	28.00	99,600
12.60	17,160	14.60	25,040	18.20	42,100	29.00	106,600
12.70	17,490	14.70	25,480	18.40	43,100	30.00	113,600
12.80	17,830	14.80	25,920	18.60	44,100	31.00	120,600
12.90	18,180	14.90	26,360	18.80	45,100	32.00	127,600
13.00	18,540	15.00	26,800	19.00	46,100	33.00	135,000
13.10	18,910	15.20	27,700	19.50	48,600	34.00	143,000
13.20	19,290	15.40	28,600	20.00	51,300	35.00	151,000
13.30	19,680	15.60	29,500	20.50	54,050	36.00	159,000
13.40	20,080	15.80	30,400	21.00	56,800	37.00	167,000
13.50	20,480	16.00	31,300	21.50	59,550	38.00	175,000
13.60	20,880	16.20	32,200	22.00	62,300	39.00	183,000
13.70	21,280	16.40	33,100	22.50	65,050	40.00	191,000
13.80	21,680	16.60	34,100	23.00	67,800	41.00	199,000
13.90	22,080	16.80	35,100				

The above table is applicable only for open-channel conditions. It is based on three discharge measurements, besides slope and weir measurements. It is well defined. These gage heights refer to the lower gage.

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905.

[Lowest stage (3.2 feet) November 21, 1887. Drainage area, 5,430 square miles.]

Date.	Gage[a] height.	Discharge.	Date.	Gage height.	Discharge.
1886.	*Feet.*	*Sec.-feet.*	1887.	*Feet.*	*Sec.-feet.*
March 31	16.5	33,600	February 3	14.0	22,500
April 1	27.0	92,600	February 4	31.0	120,600
April 2	23.5	70,800	February 5	24.0	73,800
April 2	13.5	20,480	February 6	16.3	32,650
April 3	18.5	43,600	February 26	11.7	14,500
April 5	25.0	79,800	February 27	28.0	99,600
April 6	26.0	85,800	February 28	24.0	73,800
April 7	19.5	48,600	March 1	16.3	32,650
May 8	6.5	.....	1888.		
May 9	22.0	62,300	January 8	19.5	48,600
May 10	16.5	33,600	January 9	20.7	55,150
May 10	11.5	.....	January 10	16.5	33,600
May 10	10.2	.....	July 9	6.4	.....
May 10	15.3	28,150	July 10	26.0	85,800
May 10	21.2	57,900	July 11	42.0	207,000
May 10	24.3	75,600	July 12	27.0	92,600
May 10	16.5	33,600	July 13	14.5	.....

[a] These gage heights refer to the lower gage.

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905—Continued.

Date.	Gage height.	Discharge.
1889.	*Feet.*	*Sec.-feet.*
February 17	12.7	17,490
February 18	27.0	92,600
February 19	25.5	82,800
February 20	19.5	48,600
April 13	13.0	18,540
April 14	21.0	56,800
April 15	17.7	39,600
May 31	8.7	.....
June 1	25.0	79,800
June 2	19.4	48,100
November 9	11.9	15,000
November 10	21.4	59,000
November 11	18.0	41,100
1890.		
January 7	10.0	.....
January 8	20.5	54,050
January 9	20.0	51,300
January 10	16.4	33,100
February 3	10.8	.....
February 4	21.1	57,350
February 5	21.1	57,350
February 6	16.2	32,200
February 20	11.0	.....
February 21	23.5	70,800
February 22	19.5	48,600
March 22	19.5	48,600
March 23	31.8	126,200
March 24	28.5	103,100
March 25	18.8	45,100
October 12	11.8	14,800
October 13	20.1	51,850
October 14	24.3	75,600
October 15	21.5	59,550
October 16	15.0	26,800
1891.		
January 1	9.0	.....
January 2	27.0	92,600
January 3	31.3	122,700
January 4	20.8	55,700
January 5	14.1	22,920
February 10	17.0	36,100
February 11	24.0	73,800
February 12	18.8	45,100
February 16	12.3	16,210
February 17	21.8	61,200
February 18	20.5	54,050
February 19	16.3	32,650
February 22	19.0	46,100
February 23	20.4	53,500
February 24	15.3	28,150
1892.	*Feet.*	*Sec.-feet.*
January 13	11.0	.....
January 14	25.7	84,000
January 15	28.5	103,100
January 16	19.3	47,600
April 23	18.0	41,100
April 24	21.6	60,100
April 25	15.5	29,050
1893.		
January 29	16.5	33,600
January 30	23.5	70,800
January 31	18.2	42,100
1895.		
January 6	7.3	.....
January 7	24.5	76,800
January 8	30.0	113,600
January 9	22.0	62,300
January 10	15.3	30,400
January 11	21.9	61,750
January 12	19.0	46,100
March 15	14.5	24,600
March 16	21.0	56,800
March 17	21.7	60,650
March 18	16.4	33,100
1896.		
March 19	11.2	.....
March 20	20.5	54,050
March 21	18.6	44,100
July 30	14.2	23,340
July 31	25.3	81,600
August 1	24.0	73,800
August 2	15.6	29,500
1897.		
February 22	16.0	31,300
February 23	36.0	159,000
February 24	36.0	159,000
February 25	23.0	67,800
February 26	14.0	22,500
May 14	19.7	49,650
May 15	20.6	54,600
May 16	14.6	25,040
December 5	8.0	.....
December 6	20.6	54,600
December 7	15.6	29,500
1898.		
January 10	14.0	22,500
January 11	23.9	73,200
January 12	20.0	51,300
January 13	15.8	30,400
January 16	19.5	48,600

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886–1905—Continued.

Date.	Gage height.	Discharge.
1898.	*Feet.*	*Sec.-feet.*
January 17	21.0	56,800
January 18	16.0	31,300
January 23	13.5	20,480
January 24	21.9	61,750
January 25	16.7	34,600
March 17	8.5	.....
March 18	20.0	51,300
March 19	16.7	34,600
March 20	.....	.....
March 21	13.8	21,680
March 22	22.5	65,050
March 23	20.7	55,150
March 24	20.2	52,400
March 25	24.7	78,000
March 26	23.8	72,600
March 27	16.0	31,300
March 28	.....	.....
March 29	12.0	15,300
March 30	23.9	73,200
March 31	20.7	55,150
April 1	14.5	24,600
August 10	17.3	37,600
August 11	23.3	69,600
August 12	21.0	56,800
August 13	17.8	40,100
October 22	14.0	22,500
October 23	21.6	60,100
October 24	15.8	30,400
1899.		
January 6	15.0	26,800
January 7	23.5	70,800
January 8	23.0	67,800
January 9	15.6	29,500
February 4	11.5	.....
February 5	22.0	62,300
February 6	17.5	38,600
March 5	14.0	22,500
March 6	26.9	91,900
March 7	20.0	51,300
March 28	9.5	.....
March 29	23.0	67,800
March 30	23.0	67,800
March 31	16.5	33,600
1900.		
March 1	10.2	.....
March 2	21.0	56,800
March 2	19.0	46,100
November 26	17.6	39,100
November 27	33.8	141,400
November 28	22.6	65,600
November 29	14.8	25,920
1901.		
April 4	18.8	45,100
April 5	21.6	60,100
1901.	*Feet.*	*Sec.-feet.*
April 6	20.6	54,600
April 7	23.1	68,400
April 8	21.6	60,100
April 9	17.0	36,100
April 19	12.0	15,300
April 20	23.3	69,600
April 21	25.5	82,800
April 22	21.5	59,550
April 23	17.2	37,100
May 27	19.4	48,100
May 28	21.3	58,450
May 29	20.0	51,300
May 30	17.1	36,600
December 15	18.5	43,600
December 16	28.5	103,100
December 17	18.5	43,600
December 29	16.5	33,600
December 30	25.0	79,800
December 31	22.0	62,300
1902.		
January 27	9.5	.....
January 28	28.9	85,200
January 29	19.5	48,600
February 26	16.4	33,100
February 27	21.5	59,550
February 28	18.8	45,100
March 1	29.5	110,100
March 2	25.1	80,400
March 3	20.0	51,300
March 4	15.6	29,500
March 9	11.3	.....
March 10	21.6	60,100
March 11	19.6	49,100
April 9	17.2	37,100
April 10	20.1	51,850
April 11	22.0	62,300
April 12	22.7	66,150
April 13	21.5	59,550
April 14	17.7	39,600
December 12	20.0	51,300
December 13	25.0	79,800
December 14	26.2	87,000
December 15	19.0	46,100
December 16	17.0	36,100
December 17	26.0	85,800
December 18	20.5	54,000
December 19	14.5	24,600
1903.		
January 3	10.9	.....
January 4	22.1	62,850
January 5	18.9	45,600
February 4	16.0	31,300
February 5	21.7	60,650
February 6	17.8	40,100
February 15	10.5	.....

Flood flow of the Monongahela River at Lock No. 4, Pa., 1886-1905—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1903.	*Feet.*	*Sec.-feet.*	1904.	*Feet.*	*Sec.-feet.*
February 16	22.5	65,600	March 23	14.2	23,340
February 17	28.4	102,400	March 24	20.2	52,400
February 18	19.2	47,100	March 25	16.8	35,100
February 28	14.6	25,040	1905.		
March 1	32.5	131,100	January 11	10.2	.....
March 2	24.6	77,400	January 12	24.3	75,600
March 3	15.7	29,950	January 13	19.5	48,600
March 23	13.0	18,540	March 8	12.0	15,300
March 24	23.2	69,000	March 9	21.0	56,800
March 25	21.0	56,800	March 10	28.3	101,700
March 26	14.6	25,040	March 11	29.3	108,700
1904.			March 12	18.5	43,600
January 22	13.8	21,680	March 21	16.5	33,600
January 23	21.2	57,900	March 22	27.2	94,000
January 24	20.0	51,300	March 23	20.5	54,050
January 25	16.8	24,600	March 24	13.4	20,080

CHEAT RIVER NEAR MORGANTOWN, W. VA.

A cable station was established July 8, 1899, by E. G. Paul, at Uneva, about 7 miles from Morgantown, W. Va. July 26, 1901, the cable was moved about 1 mile downstream in order to secure a more satisfactory cross section and better facilities for observing gage heights.

The channel is straight for about 800 feet above and 1,200 feet below the station. The right bank is low and liable to overflow; the left bank is high. The bed of the stream is of rocks and gravel and the current is sluggish.

A timber gage was established at the present station August 21, 1902. It is located 275 feet below the cable and is inclined up to 6.5 feet, above which point readings are taken on a vertical timber spiked to an ash tree. The bench mark is a mark on the face of a sandstone rock at the edge of the road 20 feet downstream and 30 feet back from the gage; elevation, 21.13 feet above gage datum. On September 28, 1904, a standard chain gage was installed on the new steel bridge, known as Ice's Ferry Bridge, near the site of the first cable, and both gages have been read since that time. They were set to read the same and their records have checked very closely. The published record is that for the inclined gage.

This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geolgical Survey:

Description: 36, pp 160-161; 48, p 177; 65, p 290; 83, p 184; 98, p 245; 128, p 52.
Discharge: 36, p 161; 48, p 177; 65, p 290; 83, p 184; 98, p 245; 128, p 53.
Discharge, monthly: 75, p 100.
Gage heights: 36, p 161; 48, p 177; 83, p 185; 98, p 246; 128, p 53.
Rating table: 65, p 323.

Discharge measurements of Cheat River near Morgantown, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
March 17[a]	Grover and Morse	388	2,754	2.08	4.80	5,717
March 17[b]	do	320	1,946	3.05	5.62	5,945

[a] Measurement made from bridge. Gage height referred to chain gage.
[b] Measurement made from cable. Gage height referred to inclined staff gage.

Daily gage height, in feet, of Cheat River near Morgantown, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	2.95	5.35	4.1	4.4	5.9	3.7	4.05	2.7	2.0	3.55	5.2
2	3.6	2.85	4.55	4.0	4.05	5.25	4.15	3.8	2.65	2.0	3.35	4.7
3	3.6	2.9	4.1	3.85	3.85	4.4	3.8	3.45	2.5	2.0	3.15	8.25
4	3.65	2.85	3.75	3.8	3.7	3.75	3.65	3.05	2.5	2.1	3.1	8.0
5	3.45	2.9	3.7	3.8	3.8	3.55	4.75	2.9	2.45	2.05	3.0	6.15
6	3.4	2.9	4.7	4.2	4.35	3.4	4.15	3.4	2.4	2.1	3.05	5.1
7	3.45	3.1	5.55	4.9	3.95	3.5	3.8	3.2	2.4	2.1	3.4	4.55
8	3.35	3.4	8.2	5.05	3.8	3.65	3.8	3.35	2.35	2.1	3.6	4.2
9	3.2	3.85	11.25	4.85	3.8	3.45	4.05	3.05	2.3	2.1	3.5	4.0
10	3.2	5.95	12.65	4.8	3.55	3.3	3.7	3.15	2.3	2.0	3.45	3.9
11	3.3	4.8	8.75	5.8	3.45	3.15	3.65	3.15	2.85	2.0	3.35	3.6
12	6.45	4.35	7.05	5.75	7.3	3.65	3.6	3.15	4.15	2.3	3.1	3.55
13	9.85	7.4	6.2	4.75	7.45	4.55	3.75	3.0	4.1	3.4	3.0	3.45
14	7.05	6.25	5.8	4.6	5.9	4.25	4.45	3.3	3.6	3.2	3.0	3.4
15	5.45	8.5	5.4	4.4	8.5	3.6	3.85	5.2	3.05	2.9	2.9	3.3
16	4.85	8.3	5.2	4.2	6.75	3.25	3.65	5.6	2.9	2.8	3.0	3.2
17	3.95	8.35	5.75	4.05	6.2	3.0	3.45	5.45	2.7	2.55	3.4	3.15
18	3.85	7.65	6.05	3.8	5.25	3.0	3.1	4.3	2.65	2.4	3.55	3.1
29	3.8	6.7	6.85	3.7	4.8	3.0	2.9	4.0	2.5	2.45	3.4	3.2
20	3.8	6.55	8.2	3.7	4.45	3.0	3.8	3.5	2.45	6.6	3.35	3.2
21	3.8	6.55	10.85	4.6	4.1	3.05	4.3	3.45	2.4	6.0	3.05	5.1
22	3.6	7.0	9.35	5.65	2.85	5.3	3.7	3.05	2.3	5.2	2.8	5.85
23	3.5	8.0	7.25	5.35	3.55	5.25	3.8	2.9	2.3	4.65	2.65	5.95
24	3.4	7.9	6.1	4.65	3.5	4.85	5.5	2.75	2.25	3.25	2.45	6.05
25	3.2	7.5	6.65	4.35	3.3	5.9	4.35	4.35	2.2	3.1	3.3	4.95
26	2.8	7.85	6.55	4.05	3.2	5.0	3.7	5.25	2.1	4.15	3.3	4.15
27	2.95	7.25	6.05	4.35	3.1	6.9	3.55	4.25	2.1	5.25	3.3	4.2
28	2.9	6.3	5.6	5.9	3.0	5.45	3.25	3.75	2.1	4.55	3.3	4.0
29	2.95	.....	5.1	5.4	3.0	4.5	3.2	3.55	2.0	3.9	5.1	4.15
30	3.0	.....	4.85	4.95	2.95	3.9	5.15	2.9	2.0	3.8	7.3	4.25
31	3.15	.....	4.65	.....	3.2	.....	4.6	2.9	.....	3.65	.....	4.15

NOTE.—These gage heights are referred to the inclined staff gage.

YOUGHIOGHENY RIVER NEAR CONFLUENCE, PA.

This station was established September 15, 1904, by E. C. Murphy. It is located at the highway bridge about one-half mile from the railway station at Confluence, Pa.

The channel is straight for about 200 feet above and 500 feet below the station. The current is swift. The right bank is high and does not overflow; the left bank is low, clean, and overflows during high water. The bed of the stream is rocky. There are two channels at all stages. There is a small cobblestone dam about 4 to 6 inches high under the bridge.

Discharge measurements are made from the upstream side of the two-span steel bridge. The initial point for soundings is the center of the bridge pin over the right abutment on the upstream side of the bridge.

A standard chain gage, which is read once each day by L. L. Mountain, is fastened to the downstream hand rail of the bridge; length of chain, 23.26 feet. The gage is referred to bench marks as follows: (1) A cross on the head of a rivet in the bedplate at the right abutment on the downstream side; elevation, 20.53 feet. (2) A cross on the lower chord of the bridge under the gage box; elevation, 20.28 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 56–57.

Discharge measurements of Youghiogheny River near Confluence, Pa., in 1905.

Date.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	E. C. Murphy	260	1,365	4.52	7.02	6,164
March 11	do	260	1,303	4.32	6.81	5,628
March 15	Grover and Morse	240	699	3.42	4.41	2,380
March 16	do	240	699	3.36	4.42	2,344
March 28	E. C. Murphy	231	553	3.39	3.78	1,872
April 17	A. H. Horton	203	295	2.27	2.61	670
April 22	do	231	550	2.85	3.79	1,567
June 5	R. H. Bolster	203	256	2.08	2.41	534
November 4	Hanna and Grieve	203	251	1.99	2.30	499

Daily gage height, in feet, of Youghiogheny River near Confluence, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.45	2.35	3.55	2.75	2.55	3.2	2.45	3.6	2.1	1.6	2.5	3.95
2	2.35	2.3	.....	2.6	2.4	2.8	3.65	3.0	2.05	1.6	2.4	3.5
3	2.6	2.35	.....	2.6	2.35	2.7	3.15	2.7	2.05	1.8	2.3	8.05
4	2.5	2.3	3.55	2.5	2.25	2.5	3.0	2.55	2.05	1.75	2.3	5.6
5	2.45	.....	.....	2.55	2.25	2.4	3.9	2.5	2.1	1.7	2.3	4.35
6	2.4	.....	.....	2.65	2.3	2.3	3.6	2.35	2.2	1.65	2.45	3.7
7	2.25	.....	5.4	2.75	2.3	3.0	4.5	2.2	2.25	1.65	2.4	3.35
8	2.2	2.55	5.45	2.9	2.35	2.9	4.8	2.1	2.55	1.6	2.35	3.1
9	2.1	.....	7.85	2.9	2.25	2.75	3.85	2.1	2.75	1.6	2.3	2.9
10	2.15	.....	8.7	3.05	2.25	2.6	3.3	2.05	2.9	1.55	2.3	2.8
11	2.2	2.65	6.75	3.95	2.4	4.7	3.15	2.3	3.5	1.7	2.2	2.75
12	2.45	.....	5.65	3.55	3.0	3.6	3.0	2.2	3.75	2.3	2.2	2.7
13	6.35	.....	5.05	3.3	2.85	3.5	3.1	2.1	3.1	2.2	2.15	2.6
14	4.7	.....	4.7	2.95	3.2	3.1	2.85	2.05	2.6	2.0	2.15	2.5
15	3.55	3.05	4.45	2.85	4.05	2.7	2.55	4.5	2.2	1.9	2.2	2.4
16	3.15	.....	4.45	2.75	3.85	2.45	2.35	4.1	2.15	1.8	2.2	2.35
17	2.9	.....	5.7	2.6	3.7	2.4	2.2	3.2	2.1	1.75	2.3	2.3
18	2.75	3.35	6.45	2.6	3.4	2.3	2.15	2.7	2.05	1.7	2.3	2.25
19	2.6	.....	8.7	2.5	3.0	2.2	2.1	2.4	2.0	1.9	2.35	2.25
20	2.55	.....	8.45	2.75	2.85	2.2	2.2	2.3	1.95	6.15	2.2	2.2
21	2.5	.....	10.25	3.05	2.75	2.1	2.7	2.2	1.9	4.1	2.1	3.8
22	2.4	3.45	8.05	3.8	2.6	3.35	2.4	2.1	1.8	3.25	2.05	4.6
23	2.45	.....	5.85	3.45	2.5	3.1	2.3	2.1	1.8	2.8	2.05	4.2
24	2.35	.....	4.9	3.1	2.35	3.4	2.7	2.0	1.8	2.6	2.0	4.0
25	2.4	3.55	5.2	3.0	2.3	3.0	2.5	2.5	1.8	2.5	2.1	3.5
26	2.4	.....	4.55	2.8	2.25	2.8	2.25	4.0	1.75	3.5	2.05	3.1
27	2.3	.....	4.15	2.9	2.2	3.45	2.1	2.95	1.7	3.3	2.05	2.95
28	2.35	.....	3.7	2.85	2.15	2.9	2.05	2.65	1.7	3.0	2.40	2.85
29	2.3	.....	3.3	2.85	2.0	2.6	2.4	2.3	1.65	2.8	5.40	3.1
30	2.35	.....	3.15	2.6	2.05	2.5	4.4	2.25	1.6	2.65	5.35	2.85
31	2.3	.....	2.9	.....	2.1	.....	4.0	2.2	.....	2.55	.....	2.75

NOTE.—From February 5 to March 6 river was frozen entirely across, except for narrow channel of open water under the gage. Thickness of ice, 0.7–1 foot.

Station rating table for Youghiogheny River near Confluence, Pa., from September 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	35	2.60	674	3.90	1,801	6.40	5,070
1.40	57	2.70	746	4.00	1,907	6.60	5,390
1.50	85	2.80	820	4.20	2,125	6.80	5,710
1.60	118	2.90	896	4.40	2,351	7.00	6,040
1.70	156	3.00	974	4.60	2,585	7.20	6,375
1.80	199	3.10	1,055	4.80	2,727	7.40	6,715
1.90	247	3.20	1,139	5.00	3,077	7.60	7,065
2.00	299	3.30	1,226	5.20	3,337	7.80	7,420
2.10	354	3.40	1,316	5.40	3,604	8.00	7,780
2.20	412	3.50	1,407	5.60	3,880	8.50	8,695
2.30	473	3.60	1,501	5.80	4,166	9.00	9,620
2.40	537	3.70	1,598	6.00	4,460	9.50	10,560
2.50	604	3.80	1,698	6.20	4,760	10.00	11,510

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904–5. It is well defined between gage heights 1.3 feet and 7 feet. The table has been extended above 7 feet.

Estimated monthly discharge of Youghiogheny River near Confluence, Pa., for 1904–5.

[Drainage area, 392 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 16–30	101	46	58.9	0.150	0.084
October	156	27	62.4	.159	.183
November	57	35	49.3	.126	.141
December (17 days)	2,851	57	836	2.13	1.35
1905.					
January	4,992	354	806	2.06	2.38
March 7–31	11,985	896	4,425	11.30	10.51
April	1,854	604	924	2.36	2.63
May	1,961	299	714	1.82	2.10
June	2,705	354	893	2.28	2.54
July	2,727	326	1,012	2.58	2.97
August	2,467	299	718	1.83	2.11
September	1,648	118	534	1.36	1.52
October	4,685	101	629	1.60	1.84
November	3,604	299	646	1.65	1.84
December	7,870	412	1,414	3.61	4.16

NOTE.—No estimate during frozen period.

CASSELMAN RIVER AT CONFLUENCE, PA.

This station was established September 15, 1904, by E. C. Murphy. It is located at the highway bridge in Confluence, Pa., about 500 yards from the railroad station.

The channel is straight for 200 feet above and 500 feet below the station. The current is swift. The right bank is high and is not subject to overflow. The left bank is low and overflows during extreme high water. The bed of the stream is covered with bowlders and there is some vegetation. There are two channels at all stages.

Discharge measurements are made from the upper side of the two-span steel bridge. The initial point for soundings is the center of the bridge pin over the right abutment on the upstream side.

A standard chain gage, which is read once each day by L. L. Mountain, is fastened to the upstream hand rail of the bridge; length of chain, 21.41 feet. The gage is referred to bench marks as follows: (1) A chisel draft marked with paint on the right abutment on the downstream side; elevation, 17.88 feet. (2) A cross on the top of the lower chord of the bridge near the gage; elevation, 18.61 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 57–58.

Discharge measurements of Casselman River at Confluence, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	E. C. Murphy	248	1,186	3.11	6.16	[a] 3,688
March 15	Grover and Morse	247	609	3.70	4.02	2,253
March 15	do	230	576	3.74	3.89	2,155
March 16	do	231	605	3.68	3.99	2,230
March 28	E. C. Murphy	229	516	3.63	3.59	1,870
April 17	A. H. Horton	214	344	2.25	2.63	772
April 22	do	228	559	3.54	3.73	1,980
June 6	R. H. Bolster	205	214	1.29	2.02	277
November 4	Hanna and Grieve	233	330	1.59	2.30	526

[a] Influenced by backwater from Youghiogheny River.

Daily gage height, in feet, of Casselman River at Confluence, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.15	.....	2.9	2.7	2.4	2.2	2.4	2.6	2.2	1.7	2.5	3.2
2	2.10	.....	.....	2.6	2.25	2.3	2.95	2.25	2.1	1.8	2.4	3.0
3	2.4	.....	.....	2.55	2.25	2.2	2.55	2.1	2.1	2.5	2.3	8.4
4	2.35	2.6	2.9	2.5	2.3	2.1	2.4	2.0	2.1	2.25	2.3	5.1
5	2.3	.....	.....	2.5	2.35	2.05	2.3	2.3	2.2	2.0	2.3	4.35
6	2.2	.....	.....	2.55	2.55	2.0	2.4	2.25	2.25	1.8	2.3	3.3
7	2.15	.....	3.5	2.65	2.5	2.5	3.25	2.1	2.35	1.75	2.3	3.0
8	2.1	2.7	4.6	2.7	2.45	2.75	3.6	2.0	2.65	1.7	2.3	2.9
9	2.1	.....	6.85	2.7	2.4	2.6	2.9	1.95	2.85	1.7	2.25	2.8
10	2.1	.....	7.3	2.75	2.3	2.5	2.6	1.9	2.95	1.65	2.2	2.7
11	2.15	2.7	5.6	3.5	2.25	5.7	3.1	3.2	4.85	1.95	2.15	2.6
12	2.35	.....	4.8	3.4	2.55	4.1	2.75	2.8	3.8	2.8	2.15	2.5
13	4.7	.....	4.5	3.05	2.4	3.35	2.8	2.4	2.9	2.35	2.1	2.4
14	3.8	.....	4.25	2.85	2.75	3.0	2.5	2.3	2.5	2.15	2.1	2.3
15	2.95	2.9	4.0	2.8	3.4	2.65	2.3	5.4	2.2	2.05	2.1	2.2
16	2.5	.....	4.0	2.7	3.2	2.45	2.2	4.25	2.2	2.0	2.2	2.15
17	2.45	.....	5.5	2.6	3.1	2.4	2.1	3.2	2.2	1.95	2.25	2.15
18	2.4	2.9	6.3	2.55	2.8	2.3	2.0	2.8	2.15	1.9	2.25	2.2
19	2.4	.....	9.0	2.5	2.65	2.2	2.0	2.5	2.1	2.15	2.15	2.15
20	2.35	.....	8.5	2.65	2.5	2.2	2.9	2.35	2.05	6.1	2.05	2.1
21	2.35	.....	10.4	2.95	2.4	2.1	2.35	2.2	2.0	3.7	2.0	4.0
22	2.25	2.9	7.5	3.7	2.35	3.35	2.2	2.2	1.95	3.0	2.0	4.3
23	2.25	.....	5.25	3.2	2.25	3.3	2.1	2.1	1.9	2.7	2.0	3.7
24	2.25	.....	4.4	2.9	2.2	3.7	2.5	2.0	1.9	2.6	2.0	3.4
25	2.2	2.9	4.9	2.8	2.15	3.2	2.25	3.2	1.85	2.5	1.95	3.0
26	2.2	.....	4.15	2.7	2.1	2.9	2.1	3.0	1.85	3.2	1.95	2.8
27	.....	.....	3.95	2.75	2.4	2.8	2.05	2.5	1.8	3.0	2.0	2.7
28	.....	.....	3.5	2.75	2.2	2.5	2.0	2.3	1.8	2.8	2.35	2.6
29	.....	.....	3.2	2.65	2.0	2.3	2.1	2.2	1.8	2.6	5.65	3.0
30	.....	.....	3.0	2.5	2.0	2.2	2.6	2.55	1.8	2.55	4.75	2.7
31	.....	.....	2.85	.....	2.15	.....	3.0	2.3	.....	2.5	.....	2.5

NOTE.—From January 27 to March 6 river frozen entirely across. Thickness of ice, 0.6–0.8 foot. During this time gage read to top of ice. February 15 water overflowed ice and froze under gage, increasing the reading 0.2 foot, approximately.

Station rating table for Casselman River at Confluence, Pa., from September 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	30	2.20	408	2.90	1,070	3.50	1,715
1.60	58	2.30	491	3.00	1,175	3.60	1,825
1.70	95	2.40	579	3.10	1,281	3.70	1,935
1.80	141	2.50	671	3.20	1,388	3.80	2,045
1.90	196	2.60	767	3.30	1,496	3.90	2,155
2.00	260	2.70	866	3.40	1,605	4.00	2,265
2.10	331	2.80	967				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904–5. It is fairly defined between gage heights 1.5 feet and 4 feet. Owing to backwater from Youghiogheny River the discharge for higher gage heights is liable to be in considerable error and is therefore only approximate.

Estimated monthly discharge of Casselman River at Confluence, Pa., for 1904–5.

[Drainage area, 482 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 16–30	44	22	28.5	0.059	0.033
October	58	14	26.0	.054	.062
November	44	17	26.2	.054	.060
December 1–10, 24–31	2,368	44	467	.969	.649
1905.					
January 1–26	2,881	331	643	1.33	1.29
March 7–31	4,763	1,018	2,910	6.04	5.62
April	1,935	671	964	2.00	2.23
May	1,605	260	630	1.31	1.51
June	3,457	260	913	1.89	2.11
July	1,825	260	690	1.43	1.65
August	3,299	196	752	1.56	1.80
September	2,981	141	551	1.14	1.27
October	3,658	76	656	1.36	1.57
November	3,431	228	580	1.20	1.34
December	4,468	331	1,224	2.54	2.93

NOTE.—No estimates for ice period.

LAUREL HILL CREEK AT CONFLUENCE, PA.

This station was established September 15, 1904, by E. C. Murphy. It is located at the highway bridge near the tannery, about one-fourth of a mile from the railroad station at Confluence, Pa.

The channel is straight for 25 feet above and 300 feet below the station. The current is swift. The right bank is low, clean, and subject to overflow during high water. The left bank is high and not subject to overflow. The bed of the stream is composed of rough cobblestones and is permanent. There is one channel at all except freshet stages.

Discharge measurements are made from the lower side of the single-span steel bridge. The initial point for soundings is the center of the bridge pin over the left abutment on the left side of the bridge.

A standard chain gage, which is read once each day by L. L. Mountain, is fastened to the downstream hand rail of the bridge; length of chain, 17.52 feet. The gage is referred to bench marks as follows: (1) A cross on the top of a bolt in the bedplate of the bridge at the right abutment; elevation, 14.16 feet. (2) A cross on the lower chord of the bridge under the gage box; elevation, 14.74 feet. Elevations refer to datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 58–59.

Discharge measurements of Laurel Hill Creek at Confluence, Pa., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square Feet.*	*Feet per second.*	*Feet.*	*Second-Feet.*
March 11	E. C. Murphy	100	293	3.18	3.70	933
March 11	do	100	262	3.45	3.63	903
March 15	Grover and Morse	100	214	2.78	3.05	595
March 16	do	100	220	3.04	3.11	665
March 28	E. C. Murphy	98	196	2.89	2.98	568
April 17	A. H. Horton	90	167	1.45	2.45	242
April 22	do	100	228	3.00	3.21	684
June 6	R. H. Bolster	87	114	.52	1.98	59
November 4	Hanna and Grieve	90	167	1.02	2.30	171

Daily gage height, in feet, of Laurel Hill Creek at Confluence, Pa., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	.....	2.85	2.45	2.45	2.05	2.35	2.8	2.15	1.8	2.4	3.15
2	2.3	.....	.....	2.35	2.4	2.05	2.45	2.5	2.1	1.8	2.3	3.0
3	2.5	.....	.....	2.3	2.35	2.0	2.3	2.35	2.1	2.1	2.3	6.85
4	2.45	2.25	2.85	2.3	2.35	2.0	2.25	2.4	2.1	1.95	2.3	4.05
5	2.45	.....	.....	2.35	2.45	2.0	2.2	2.3	2.25	1.85	2.4	3.3
6	2.4	.....	.....	2.4	2.4	1.9	2.2	2.25	2.3	1.75	2.4	2.95
7	2.25	.....	.....	2.45	2.3	2.7	2.2	2.25	2.3	1.7	2.35	2.75
8	2.15	2.9	3.65	2.45	2.25	2.5	2.3	1.9	2.6	1.7	2.35	2.65
9	2.05	.....	4.85	2.4	2.15	2.4	2.15	1.9	2.8	1.7	2.3	2.55
10	2.0	.....	5.2	2.45	2.15	2.3	2.3	1.85	2.9	1.65	2.25	2.45
11	2.05	2.85	3.85	2.9	2.2	4.45	2.2	2.8	4.15	2.3	2.2	2.45
12	2.25	.....	3.2	2.9	2.55	3.7	2.2	2.55	3.1	2.4	2.2	2.4
13	3.7	.....	3.2	2.7	2.45	3.1	2.3	2.3	2.9	2.15	2.2	2.4
14	3.3	.....	3.15	2.6	2.95	2.75	2.2	2.3	2.55	2.05	2.2	2.35
15	3.0	2.9	3.05	2.5	3.0	2.5	2.15	4.0	2.4	1.95	2.15	2.35
16	2.65	.....	3.15	2.5	2.8	2.4	2.05	4.3	2.3	1.9	2.25	2.3
17	2.6	.....	4.0	2.4	2.6	2.3	2.0	3.35	2.2	1.85	2.25	2.25
18	2.5	2.85	4.5	2.4	2.5	2.2	2.0	2.9	2.15	1.8	2.2	2.25
19	2.35	.....	7.65	2.4	2.4	2.15	1.9	2.6	2.1	2.2	2.2	2.2
20	2.35	.....	6.55	2.5	2.4	2.15	2.45	2.35	2.05	4.1	2.15	2.15
21	2.3	.....	7.95	2.65	2.3	2.1	2.2	2.3	2.0	3.15	2.1	3.5
22	2.25	2.9	5.2	3.15	2.25	4.6	2.1	2.3	1.95	2.65	2.1	3.5
23	2.3	.....	3.75	2.8	2.2	3.8	2.0	2.2	1.9	2.5	2.05	3.2
24	2.3	.....	3.3	2.65	2.15	3.85	2.4	2.1	1.9	2.4	2.1	2.95
25	2.2	2.85	3.5	2.6	2.15	3.4	2.2	2.35	1.9	2.35	2.05	2.75
26	2.25	.....	3.2	2.5	2.1	3.2	2.15	2.2	1.85	2.65	2.05	2.65
27	.....	.....	3.1	2.6	2.15	2.85	2.1	2.1	1.8	2.5	2.0	2.55
28	.....	.....	2.95	2.9	2.15	2.6	2.05	2.05	1.8	2.45	2.5	2.5
29	.....	.....	2.7	2.65	2.1	2.45	2.3	2.0	1.8	2.35	4.75	3.1
30	.....	.....	2.6	2.55	2.15	2.35	2.4	2.3	1.8	2.35	3.9	2.75
31	.....	.....	2.5	.....	2.05	.....	3.25	2.2	.....	2.3	.....	2.6

NOTE.—Creek frozen over January 27 to March 7, inclusive. During this period gage was read to top of ice. Thickness of ice, 0.7-1 foot.

Station rating table for Laurel Hill Creek at Confluence, Pa., from September 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	7	2.10	93	2.50	266	2.90	503
1.70	13	2.20	128	2.60	321	3.00	568
1.80	24	2.30	169	2.70	379	3.10	634
1.90	41	2.40	215	2.80	440	3.20	701
2.00	64						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904-5. It is well defined between gage heights 1.8 feet and 3.2 feet. Above 3.2 feet the discharge is estimated and may be considerably in error, as the creek is affected by backwater from Casselman and Youghiogheny rivers.

Estimated monthly discharge of Laurel Hill Creek at Confluence, Pa., for 1904-5.

[Drainage area, 126 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 16-30	24	10	13.7	0.109	0.061
October	24	7	10.8	.086	.099
November	13	7	10.8	.086	.096
December 1-11, 26-31	882	13	191	1.52	.961
1905.					
January 1-26	916	64	247	1.96	1.90
March 8-31	1,106	266	793	6.29	5.61
April	668	169	304	2.41	2.69
May	568	78	204	1.62	1.87
June	1,080	41	375	2.98	3.32
July	730	41	153	1.21	1.40
August	1,044	32	258	2.05	2.36
September	1,019	24	192	1.52	1.70
October	1,010	10	169	1.34	1.54
November	1,091	64	201	1.60	1.78
December	1,056	110	427	3.39	3.91

NOTE.—No estimates for ice period.

BEAVER RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Beaver river is formed by the junction of Mahoning and Shenango rivers just below Newcastle, Pa. Mahoning River flows through a hilly and important territory. There are numerous water-power developments on it, and it forms an important adjunct in the water supply and sewage disposal of many towns along its course.

MAHONING RIVER AT YOUNGSTOWN, OHIO.

This station was established May 23, 1903. It is located about 2 miles below the center of the city of Youngstown, Ohio, at the highway bridge near the plant of the Hazelton Steel Company.

The channel is straight for about 800 feet above and 200 feet below the bridge, and is 200 feet wide between abutments. The left bank is fairly high and is subject to overflow only at extremely high water. The right bank is low and overflows in floods. The section is fairly regular and the bed of the stream is composed of gravel and small bowlders, probably not subject to change. The current is sluggish at extremely low water.

Discharge measurements are made from the single-span highway bridge. The initial point for soundings is the face of the parapet wall of the east abutment on the upstream side.

The vertical gage, consisting of a 1 by 6 inch board nailed to stakes driven in the river bed 15 feet from the east abutment, was used up to September 23, 1903, when a standard chain gage was installed, having a length of 25.36 feet from the end of the weight to the marker. The gage was read during 1905 by John McVean. Bench marks were established as follows: (1) The top of the copper bolt on the face of the east abutment near the upstream corner; elevation, 9.37 feet. (2) The northwest corner of the bridge seat of the west abutment; elevation 17.12 feet. (3) A cut in the end stone of the second tier from the top of the north wing wall of the west abutment; elevation; 21.34 feet. (4) A cut in the top hand rail at a point 35 feet from the east abutment on the upstream side; elevation, 25.88 feet. The elevation of the center of the pulley on which the chain of the gage runs is 23.61 feet. Elevations refer to datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 98, p 238; 128, p 60.
Discharge: Ann 20, iv, p 198; WS 98, p 239; 128, p 60.
Discharge, monthly: WS 128, p 62.
Gage heights: WS 98, p 239; 128, p 61.
Rating table: WS 128, p 61.

Discharge measurements of Mahoning River at Youngstown, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 18 [a]	R. Winthrop Pratt	75	119	0.96	1.41	422
May 23	M. S. Brennan	156	389	.71	1.09	276
June 22	Sidney K. Clapp	160	602	1.85	2.25	1,116
October 5	R. Winthrop Pratt	158	482	.96	1.51	465
November 3	do	158	443	.75	1.40	332

[a] Ice gorge below.

Daily gage height, in feet, of Mahoning River at Youngstown, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	0.75	2.4	1.4	1.15	1.15	1.0	1.6	1.15	0.85	1.25	4.3
2	1.5	.72	1.95	1.45	1.15	.95	1.15	1.15	1.05	.9	1.3	3.9
3	1.15	.7	1.75	1.3	.95	.98	1.95	.95	.9	1.1	1.35	4.0
4	1.1	.65	1.7	1.22	.95	.....	1.5	.75	.8	1.2	1.3	5.0
5	1.15	.6	1.7	1.2	1.0	.....	1.6	.6	1.0	1.3	1.2	3.55
6	1.17	.72	2.15	1.15	.95	.....	1.55	.75	.92	1.25	1.5	2.6
7	1.1	.7	2.8	1.1	1.0	.....	1.4	.85	1.1	1.1	2.5	2.25
8	.9	.75	7.0	1.08	.95	.....	1.2	.9	.9	.95	2.4	2.2
9	.9	.8	7.0	1.15	.92	.....	1.0	1.0	.85	.85	2.05	2.15
10	.86	.78	7.0	1.1	.85	.....	.95	1.25	.7	.75	1.85	2.1
11	.9	.68	6.2	1.5	.92	.....	1.0	1.15	1.95	1.05	1.75	1.75
12	1.12	.72	3.9	1.58	4.6	.....	1.4	1.0	3.8	1.0	1.6	1.65
13	2.1	.85	3.0	1.6	5.5	2.3	6.4	3.9	3.2	1.55	1.55	1.55
14	2.8	.9	2.5	1.6	2.9	2.0	8.4	3.6	1.95	1.4	1.45	1.5
15	2.42	1.0	2.1	1.3	2.5	1.65	6.4	3.8	1.55	1.3	1.4	1.15
16	1.8	.92	1.9	1.25	2.5	1.4	2.5	2.7	1.65	1.25	1.45	1.2
17	1.5	.97	2.4	1.3	2.15	4.9	1.75	2.7	1.5	1.25	1.5	1.2
18	1.4	.84	4.0	1.5	2.3	4.8	1.55	2.6	2.4	1.25	1.7	1.1
19	1.2	.72	9.6	1.95	2.0	4.6	1.3	2.5	2.6	1.75	1.75	1.15
20	1.14	.76	11.5	2.2	1.85	2.25	5.2	2.0	3.7	2.7	1.5	1.15
21	1.1	.85	11.5	5.4	1.4	2.0	6.2	.....	4.8	3.05	1.35	3.45
22	1.2	1.05	9.0	4.2	1.3	4.9	2.6	.....	3.3	2.75	1.25	6.5
23	1.3	1.1	6.4	3.2	1.15	6.6	1.85	2.3	2.15	2.05	1.15	6.0
24	1.2	1.35	4.0	2.4	1.0	3.9	1.85	2.7	1.25	1.9	1.1	3.9
25	1.1	1.6	3.6	1.95	.85	3.0	1.35	3.6	1.45	1.75	1.1	2.8
26	1.02	2.4	3.1	1.5	.5	2.6	1.0	5.5	1.2	1.6	1.15	2.25
27	.9	2.5	2.5	1.45	3.0	1.25	.95	3.3	.95	1.4	1.3	2.05
28	.8	2.9	2.2	1.5	2.7	1.1	.75	1.9	.9	1.35	1.65	2.25
29	.76	.....	1.95	1.35	1.7	1.0	.8	1.45	.6	1.15	5.35	1.75
30	.8	.....	1.95	1.35	1.5	.9	2.25	1.25	.75	1.05	6.3	2.0
31	.76	.....	1.5	.....	1.3	.....	2.0	1.18	.....	1.1	.....	1.95

NOTE.—Practically no ice conditions at the station, owing to hot water from steel plant.

Station rating table for Mahoning River at Youngstown, Ohio, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	51	2.10	938	3.70	2,310	6.60	5,650
.60	80	2.20	1,014	3.80	2,410	6.80	5,910
.70	113	2.30	1,091	3.90	2,510	7.00	6,180
.80	151	2.40	1,170	4.00	2,610	7.20	6,460
.90	195	2.50	1,250	4.20	2,810	7.40	6,740
1.00	244	2.60	1,330	4.40	3,030	7.60	7,020
1.10	296	2.70	1,410	4.60	3,250	7.80	7,300
1.20	350	2.80	1,490	4.80	3,470	8.00	7,580
1.30	406	2.90	1,575	5.00	3,690	8.50	8,330
1.40	464	3.00	1,660	5.20	3,910	9.00	9,080
1.50	524	3.10	1,745	5.40	4,150	9.50	9,830
1.60	586	3.20	1,830	5.60	4,390	10.00	10,600
1.70	651	3.30	1,920	5.80	4,630	10.50	11,400
1.80	719	3.40	2,010	6.00	4,870	11.00	12,200
1.90	790	3.50	2,110	6.20	5,130	11.50	13,050
2.00	863	3.60	2,210	6.40	5,390		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 20 discharge measurement made during 1903-1905. It is fairly well defined between gage heights 0.9 foot and 2.5 feet. The table has been extended beyond these limits, being based on 1 measurement at 7.8 and 1 at 10.8 feet, the latter being recomputed by the use of low-water soundings. Below 0.9 foot the curve is unsatisfactory, probably owing to the influence of the dam below, as at low stages the water may fall below the crest.

Estimated monthly discharge of Mahoning River at Youngstown, Ohio, for 1905.

[Drainage area, 958 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,490	136	406	0.424	0.489
February	1,575	80	310	.324	.337
March	13,050	524	3,310	3.46	3.99
April	4,150	286	754	.787	.878
May	4,270	51	780	.814	.938
June (21 days)	5,650	195	1,518	1.58	1.23
July	8,180	132	1,351	1.41	1.63
August[a]	4,270	80	1,009	1.05	1.21
September	3,470	80	759	.792	.884
October	1,702	132	506	.528	.609
November	5,260	296	822	.858	.957
December	5,520	296	1,464	1.53	1.76

[a] Discharge interpolated for missing gage heights.

MUSKINGUM RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Muskingum River is formed by the junction of Walhonding and Tuscarawas rivers in the east-central part of Ohio, flows southward and enters Ohio River at Marietta, Ohio.

MUSKINGUM RIVER AT ZANESVILLE, OHIO.

This station was established March 11, 1905. It is located at the Sixth Street Bridge, Zanesville, Ohio, 1,000 feet above the lowest lock which is maintained by the War Department which furnishes the gage heights. It is about 3,000 feet below a dam and about the same distance below the entrance of Licking River, which also has a dam near its mouth. The drainage area of Muskingum River at this station is 5,828 square miles.

The channel is straight for 1,000 feet above and below the station. The river broadens out on the right side just above the bridge. The right bank is thinly wooded, the water being confined within the abutments of the bridge. The left bank is clean, being formed by the artificial embankment of the canal. The bed of the stream is composed of gravel and silt and is not liable to change. There is but one channel at all stages, divided by three piers at low water and five piers at high water. The current is swift above the gage height of 10 feet. All of the flow except a small amount of leakage passes between the abutments of the bridge.

Discharge measurements are made from the upstream side of the Sixth Street Bridge. The bridge consists of six spans, having a total length of 800 feet. The easternmost span of the bridge is a drawspan over the canal. The initial point for soundings is the center of the iron post forming part of the hand rail over the west abutment, upstream side.

The gage is in two sections. The lower section is graduated to feet and tenths on the wooden crib adjacent to the extreme south end of the east lock wall. The upper section is a cast-iron plate, graduated to feet and tenths, set vertically in the masonry of the east lock wall at the extreme south end. Bench marks were established as follows: (1) On top of the west wall of the lock at upper gage; elevation, 699.92 feet. (2) A square cut in the masonry on the east wall of the lock at the upper gage opposite bench mark No. 1; elevation, 699.73 feet. (3) Gage reading of 29.00 feet, at an elevation of 694.86 feet above mean sea level. (4) Miter sill, equal to the zero of the gage, which is at an elevation of 665.86 feet above mean sea level.

Discharge measurements of Muskingum River at Zanesville, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	R. W. Pratt	531	6,269	4.11	16.85	25,800
March 16	do	510	2,841	2.25	9.75	6,409
March 16	E. C. Murphy	501	2,656	2.37	9.83	6,295
May 21	M. S. Brennan	472	2,923	2.88	10.50	8,416
June 13	Sidney K. Clapp	489	4,684	3.70	13.20	17,350
July 9	do		2,474	2.27	9.20	5,628
August 28	R. W. Pratt	475	2,279	1.60	8.70	3,640
October 30	do	495	2,180	1.34	8.60	2,926
November 14	do		2,275	1.54	8.75	3,501

Daily gage height, in feet, of Muskingum River at Zanesville, Ohio, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		9	9.7	8.8	8.1	8.0	17	8.7	18	9.8	8.5	14.2	9.7
2		8.8	9.5	8.8	8.1	7.9	18	8.5	15.2	12.2	8.3	12.6	10.7
3		8.5	9.0	8.7	7.9	7.8	19	8.4	12.6	13.3	8.1	10.0	10.1
4		8.4	8.6	8.9	7.8	7.9	20	8.4	11.7	11.7	8.3	10.2	10.4
5		8.3	8.6	10.0	7.7	7.9	21	8.7	10.7	13.0	8.9	10.1	11.2
6		8.2	9.9	10.0	7.7	7.8	22	11.4	10.1	13.6	9.0	9.9	11.7
7		8.2	8.8	2.5	7.7	7.9	23	11.6	9.6	14.9	8.5	9.2	10.0
8		8.2	8.6	9.3	7.7	7.8	24	11.1	9.2	15.2	8.3	8.7	9.5
9	8.6	8.3	10.3	9.3	7.7	7.8	25	11.2	9.0	15.1	8.1	8.5	9.0
10	8.5	8.2	9.8	8.9	7.7	7.7	26	9.4	8.8	13.6	8.2	8.6	8.8
11	8.7	8.3	9.3	8.5	7.7	7.9	27	9.2	10.2	11.6	8.1	9.0	8.6
12	9.4	12.4	9.4	8.4	8.1	9.8	28	9.2	10.0	10.3	8.0	9.0	8.3
13	9.7	18.5	10.6	8.4	9.4	10.5	29	9.2	10.0	9.7	8.0	8.5	8.3
14	9.6	15.6	10.3	9.0	9.1	9.5	30	9.1	9.8	9.2	8.0	8.2	8.2
15	9.2	18.2	9.8	9.8	8.9	8.8	31		9.8		8.0	8.0	
16	8.7	18.4	9.3	8.8	12.6	8.7							

LICKING RIVER AT PLEASANT VALLEY, OHIO.

This station was established November 14, 1902. It is located at the highway bridge 300 feet north of the railroad station at Pleasant Valley, Ohio, and 9 miles northwest of Zanesville, Ohio. The drainage area of Licking River at this station is 696 square miles.

The channel is straight for 200 feet above and 500 feet below the station. The banks are high and not liable to overflow, except in extreme floods. The bed of the stream is composed of gravel and clay. The current is sluggish.

Low-water measurements are made by wading and high-water measurements from the bridge to which the gage is attached. The initial point for soundings is a cross in the top stone of the downstream side of the south abutment of the bridge.

A standard chain gage is attached to the bridge. The length of the chain from the end of the weight to the marker is 20.93 feet. The gage was read during 1905 by A. B. Lebold. The gage is referred to bench marks as follows: (1) Nails driven into a telephone pole at elevations from 12.92 to 14.92 feet, respectively. (2) Three copper nails driven into a walnut tree about 400 feet to the right of the right end of the bridge, arranged vertically and having elevations, respectively, 14.92, 15.92, and 16.92 feet. (3) A nail driven into the outside guard timber near the gage box; elevation, 21.52 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 181-182; 98, p 229; 128, p 63.
Discharge: 83, p 182; 98, p 229; 128, p 63.
Discharge, monthly: 98, p 231; 128, p 65.
Gage heights: 83, p 182; 98, pp 229-230; 128, p 64.
Rating table: 98, p 230; 128, pp 64-65.

Discharge measurements of Licking River at Pleasant Valley, Ohio, in 1904-5.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
1904.						
December 30	R. W. Pratt	78	353	1.48	3.14	524
1905.						
January 13	do	95	499	2.70	4.70	1,343
February 28	do	122	647	2.67	6.00	1,728
March 16	do	80	355	1.26	3.13	447
May 22	M. S. Brennan	79	337	1.49	2.86	502
June 19	Sidney K. Clapp	80	317	1.23	2.40	391
July 9	do	70	255	1.36	1.92	347
August 28	R. W. Pratt	65	242	.47	1.58	114
October 30	do	67	241	1.00	2.33	241
November 14	do	69	284	1.12	2.32	318

Daily gage height, in feet, of Licking River at Pleasant Valley, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	.....	5.7	2.4	2.7	3.3	1.7	1.5	1.5	1.6	2.7	4.2
2	2.6	.....	4.7	2.3	2.4	2.7	3.4	1.5	1.5	1.7	2.6	3.9
3	2.45	2.2	4.9	2.2	2.2	2.4	2.2	1.4	1.4	4.4	2.5	10.2
4	2.3	.....	3.4	2.2	2.2	2.2	2.2	1.4	1.4	3.4	2.4	6.7
5	2.3	.....	3.3	2.2	2.1	6.2	2.2	1.4	1.4	2.6	2.4	5.0
6	2.3	.....	3.3	2.1	2.0	6.4	2.0	1.4	1.4	2.2	5.0	4.9
7	2.4	.....	3.2	2.1	2.0	4.0	1.9	1.4	1.4	2.0	4.7	4.8
8	2.25	.....	8.8	2.0	2.0	3.3	1.9	1.5	1.4	1.9	3.9	4.2
9	3.0	.....	10.5	2.0	2.1	2.7	2.0	1.7	1.4	1.8	3.4	3.8
10	3.25	3.55	6.6	2.0	2.0	2.5	1.8	1.5	1.4	1.7	3.0	3.4
11	3.3	.....	4.2	2.4	2.0	2.4	1.8	1.5	2.0	1.7	2.7	3.3
12	3.5	.....	4.1	3.6	10.7	2.3	1.8	6.9	1.9	1.7	2.6	3.2
13	4.8	.....	3.7	2.9	7.3	2.2	1.8	3.4	1.8	1.7	2.5	2.8
14	3.9	.....	3.4	2.6	5.0	2.1	1.8	2.8	1.7	1.7	2.4	2.5
15	.....	.....	3.2	2.4	7.9	2.0	1.8	3.3	1.6	1.7	2.4	2.4
16	.....	.....	3.2	2.3	5.5	2.1	1.7	3.1	1.7	1.6	2.3	2.3
17	.....	3.0	3.3	2.2	6.8	4.0	1.6	3.2	5.3	1.6	2.3	2.3
18	.....	.....	3.3	2.1	4.8	3.4	1.6	2.5	3.4	1.6	2.2	2.3
19	.....	3.0	3.8	2.0	4.1	2.7	1.5	2.2	2.8	8.2	2.2	2.3
20	3.15	3.2	5.3	2.0	3.6	2.2	1.6	2.7	3.8	7.4	2.1	2.4
21	.....	3.8	5.5	2.5	3.3	4.4	1.6	2.5	3.7	5.3	2.0	4.0
22	.....	4.4	5.3	5.5	2.9	3.4	1.5	2.1	3.0	4.2	2.0	5.8
23	.....	5.3	4.4	3.8	2.7	3.6	1.5	1.9	2.4	3.2	1.9	5.1
24	.....	5.0	3.9	3.1	2.5	2.8	1.5	1.8	2.1	3.0	1.9	4.4
25	.....	6.4	3.6	2.8	2.4	2.4	1.5	1.8	1.9	2.7	2.2	3.6
26	2.25	7.1	3.3	2.5	3.3	2.2	1.5	1.8	1.8	3.0	2.2	3.3
27	.....	6.9	3.1	2.5	3.8	2.0	1.4	1.7	1.7	2.9	2.1	3.0
28	.....	5.9	2.9	2.4	2.8	1.9	1.4	1.6	1.6	2.6	2.0	3.0
29	.....	.....	2.8	2.4	2.5	1.8	1.4	1.6	1.6	2.4	6.1	3.0
30	.....	.....	2.6	2.9	2.7	1.8	1.7	1.6	1.6	2.3	5.5	3.3
31	.....	.....	2.5	.....	4.1	.....	1.5	1.5	.....	2.2	.....	3.1

NOTE.—River partly frozen January 4-13 and entirely frozen January 15 to March 2, gage being read to top of ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 20	3.15	3.15	0.35
January 27	2.15	2.25	.9
February 10	3.55	3.55	1.4
February 17	2.8	3.0	.....

KANAWHA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kanawha River, which rises in Watauga, Ashe, and Alleghany counties, N. C., flows northwestward through Virginia and West Virginia and joins Ohio River at Point Pleasant, W. Va. In its upper course it is known as New River. The headwaters lie in the Appalachian Mountains, among the high ridges which form the divides between the drainage basin of this river and Yadkin River on the east and Holston River on the west. The upper tributaries drain narrow valleys of the mountainous region of North Carolina, and their slopes are generally steep and their beds rough. The main river cuts the Allegheny Front just below Pearisburg, Va.; thence the river's course is through a narrow valley of West Virginia over a rough bed with many falls and rapids. The basin is as beautiful and picturesque as any in the eastern part of the United States. The country on its lower courses, through which the Chesapeake and Ohio Railway passes, is noted for its scenic beauty. Below the junction with the Gauley the river is known as the Kanawha.

The principal tributaries of New River are Little River, which empties near Radford, Va., and the Greenbriar, which rises in the eastern part of West Virginia and joins the New at Hinton, W. Va.

NEW RIVER AT RADFORD, VA.

This station was established August 1, 1898, by D. C. Humphreys. It is located at the highway bridge near the Norfolk and Western Railway station.

The channel is straight for several hundred feet above and below the station, and has a width of 580 feet at ordinary stages, broken by five piers. At high water its width is about 1,200 feet. The bottom is of solid rock and gravel, and is smooth and regular. On the left bank there is a steep, rocky bluff. The right bank is low and subject to overflow for about 100 yards, but all the water must pass under the bridge, which is about 85 feet above low water.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is on the right bank of the river, 50 feet from the first pier.

The gage used at first was erected by the United States Weather Bureau. It consists of a vertical board graduated to feet and tenths and is attached to the iron framework connecting the pair of iron-concrete cylinders which form the first pier from the right bank. On account of the inaccessibility of the Weather Bureau gage a wire gage was put in place February 23, 1900, the datum being the same as that of the old gage. December 1, 1903, the wire gage was replaced by a standard chain gage. At this time the gage datum was lowered 3.41 feet. The length of the chain is 87.00 feet. The gage is read twice each day by C. L. Gillaspie. The gage is referred to bench marks as follows: (1) The bottom of the lowest horizontal brace connecting the two cylinders; elevation 7.28 feet. (2) The top of the lowest horizontal brace on the west side of the bridge 2.5 feet south of the northwest post of the bent nearest the river on the right bank; elevation, 22.66 feet. (3) The northwest corner of the top of the stone under the seventh post from the right bank; elevation, 18.58 feet. Elevations refer to the datum of the chain gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 27, p 59; 36, pp 161-162; 48, p 178; 65, p 293; 83, pp 190-191; 98, pp 250-251; 128, pp 66-67.
Discharge: 27, p 65; 36, p 162; 48, p 178; 65, p 293; 83, p 191; 98, p 251; 128, p 67.
Discharge, monthly: 75, pp 101-102; 128, p 68.
Gage heights: 27, p 61; 36, p 162; 48, p 178; 65, p 294; 83, p 191; 98, p 251; 128, p 67.
Rating table: 128, p. 68.

Discharge measurements of New River at Radford, Va., 1900–1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
1900.						
June 27	D. C. Humphreys		2,450	2.82	5.03	6,900
1901.						
August 8	do		3,570	4.77	7.42	17, 30
1904.						
June 18	F. H. Brundage	566	1,965	1.83	4.07	3,610
September 16	R. H. Bolster	556	1,520	1.08	3.40	1,635
September 29	do	556	1,432	.86	3.24	1,240
October 18	do	554	1,378	.73	3.14	1,005
1905.						
March 18	A. H. Horton	560	1,910	1.76	3.98	3,353
September 11	R. H. Bolster	566	1,810	1.44	3.88	2,615

[a] All gage heights refer to datum established December 1, 1903.

NOTE.—The five circular piers at this station are a few feet below the measuring section for low-water measurements, but are included in the measuring section for high-water measurements, owing to the fact that the meter is carried downstream by the swiftness of the current. The measurements for 1904 and 1905 as given above have been computed for one unbroken channel. Measurements June 27, 1900, and August 8, 1901, have been recomputed for a channel broken by five piers.

Daily gage height, in feet, of New River at Radford, Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.4	4.5	3.7	3.5	3.8	3.3	3.9	3.6	3.5	3.5	3.2
2	3.5	3.4	4.9	3.6	3.5	3.7	3.2	3.1	3.7	3.5	3.5	3.2
3	3.5	3.8	4.9	3.7	3.4	3.6	3.7	3.1	5.0	3.5	3.5	3.5
4	3.5	3.7	4.7	3.7	3.5	3.6	3.7	3.8	4.9	3.5	3.5	5.7
5	3.0	3.7	4.8	3.6	3.5	3.3	3.5	3.5	5.2	3.4	3.4	4.8
6	3.2	4.1	4.9	4.1	3.8	3.2	5.5	3.5	4.5	3.4	3.4	4.0
7	3.5	3.8	4.6	4.6	3.9	3.2	5.0	4.6	4.4	3.3	3.4	3.8
8	3.6	3.7	4.6	4.2	3.9	3.1	4.1	5.3	4.3	3.3	3.4	3.8
9	3.5	4.0	4.7	4.1	3.8	3.2	4.0	5.2	4.0	3.3	3.4	3.7
10	3.5	3.8	5.5	4.0	3.7	3.2	3.8	5.2	3.9	3.3	3.4	3.8
11	3.6	4.0	5.8	3.8	4.6	3.1	3.5	5.9	3.8	3.3	3.5	4.1
12	3.9	3.8	5.2	3.9	6.0	3.2	6.45	6.0	3.9	3.3	3.5	4.1
13	5.2	3.8	4.7	4.2	8.1	3.2	21.6	6.1	3.8	3.3	3.5	4.1
14	5.7	4.5	4.6	4.1	7.1	3.1	10.6	5.8	3.7	3.3	3.5	3.8
15	4.4	4.8	4.4	4.3	8.2	3.2	7.2	5.3	3.8	3.7	3.5	3.8
16	4.2	4.4	4.2	4.1	8.8	3.2	6.7	5.3	3.7	3.7	3.4	3.8
17	3.8	3.9	4.0	4.0	7.4	3.3	4.8	4.8	3.6	3.5	3.4	3.8
18	3.8	3.9	4.0	3.8	6.6	3.5	4.7	4.4	3.7	3.4	3.3	3.9
19	3.7	3.7	3.8	3.6	5.0	3.5	4.6	4.4	3.6	3.4	3.3	4.0
20	4.0	3.9	3.9	3.7	4.8	3.5	4.5	4.4	3.5	3.4	3.3	4.0
21	3.8	4.2	3.8	3.7	4.2	3.5	4.4	4.2	3.5	3.4	3.3	5.6
22	4.0	4.5	3.9	3.6	4.0	3.5	4.4	3.8	3.4	3.4	3.3	6.2
23	3.7	7.8	3.8	3.6	4.0	3.3	5.3	3.8	3.4	3.4	3.3	6.1
24	3.7	5.3	3.8	3.6	3.7	3.7	5.0	3.8	3.4	3.4	3.3	5.7
25	3.6	5.2	3.7	3.5	3.8	3.7	4.7	3.6	3.4	3.4	3.3	4.9
26	3.5	5.2	3.8	3.6	3.8	3.4	4.4	4.1	3.4	3.5	3.3	4.4
27	3.4	5.4	3.7	3.4	3.9	3.4	4.0	3.8	3.4	3.7	3.3	4.2
28	3.5	4.8	3.8	3.5	4.1	3.4	4.0	3.7	3.4	3.8	3.3	4.0
29	3.4	.....	3.6	3.5	4.0	3.3	4.9	3.7	3.4	3.8	3.3	4.0
30	3.9	.....	3.7	3.4	3.7	3.3	4.8	3.7	3.4	3.6	3.3	3.9
31	3.5	.....	3.6	.....	4.0	.....	4.1	3.7	.....	3.6	.....	3.9

NOTE.—January 5 and 6, water thrown from gage by ice; January 26–29, gage read to surface of ice.

Station rating table for New River at Radford, Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	700	4.40	4,550	5.80	9,950	7.40	16,950
3.10	920	4.50	4,900	5.90	10,360	7.60	17,900
3.20	1,150	4.60	5,260	6.00	10,770	7.80	18,890
3.30	1,390	4.70	5,630	6.10	11,190	8.00	19,920
3.40	1,640	4.80	6,000	6.20	11,610	8.20	20,990
3.50	1,900	4.90	6,380	6.30	12,040	8.40	22,100
3.60	2,160	5.00	6,770	6.40	12,470	8.60	23,250
3.70	2,430	5.10	7,160	6.50	12,900	8.80	24,440
3.80	2,710	5.20	7,550	6.60	13,340	9.00	25,650
3.90	3,000	5.30	7,940	6.70	13,780	9.20	26,870
4.00	3,290	5.40	8,340	6.80	14,230	9.40	28,100
4.10	3,590	5.50	8,740	6.90	14,680	9.60	29,340
4.20	3,900	5.60	9,140	7.00	15,130	9.80	30,580
4.30	4,220	5.70	9,540	7.20	16,030	10.00	31,820

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made June 27, 1900, August 8, 1901, and in 1904–5. It is well defined between gage heights 3 feet and 7.5 feet. The table has been extended beyond these limits. Above gage height 7.5 feet the rating table is based on the extension of the area and velocity curves and is only approximate.

Estimated monthly discharge of New River at Radford, Va., for 1905.

[Drainage area, 2,725 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January [a]	9,540	1,640	2,777	1.02	1.18
February	18,890	1,640	4,509	1.65	1.72
March	9,950	2,160	4,435	1.63	1.88
April	5,260	1,640	2,763	1.01	1.13
May	24,440	1,640	6,344	2.33	2.69
June	2,710	920	1,588	.583	.650
July	123,800	1,150	10,210	3.75	4.32
August	11,190	920	4,766	1.75	2.02
September	7,550	1,640	2,885	1.06	1.18
October	2,710	1,390	1,805	.662	.763
November	1,900	1,390	1,610	.591	.659
December	11,610	1,150	4,312	1.58	1.82
The year	123,800	920	4,000	1.47	20.01

[a] Ice conditions January 5 and 6; estimates corrected. Ice January 26–29; estimates not corrected.

GREENBRIER RIVER AT ALDERSON, W. VA.

Greenbrier River rises on the western slope of the Allegheny Mountains, in Pocahontas County, W. Va., and flows in a southwesterly direction, emptying into New River near Hinton, Summers County, W. Va. It receives many short tributaries from the Allegheny Range, and flows for the most part through a broken, hilly, and mountainous country well covered with forests.

A gaging station was established August 1, 1895, by C. C. Babb. It is located at the highway bridge one-half mile above the mouth of Muddy Creek, in the village of Alderson, W. Va., 21 miles above Hinton.

The channel, which is straight for 500 feet above and below the station, is broken at the bridge by three piers. At low stages the water flows in two channels, between which is an island 600 feet long and 75 feet wide. The banks are high and not subject to overflow. The bed is of rock and gravel and is constant.

Discharge measurements are made from the bridge. The initial point for soundings is the center of the pin on the downstream side of the bridge, on the left bank.

The wire gage which was originally installed was located in the third panel of the second span, downstream side of the bridge. November 20, 1903, a standard chain gage was installed in the same position and at the same datum as the wire gage. The length of the chain is 27.81 feet. The gage is referred to bench marks as follows: (1) On the upper end of the coping of the first pier from the left bank; elevation, 21.74 feet. (2) On the upper end of the bridge seat of the left abutment; elevation, 21.61 feet. (3) The top of the water table at the northwest corner of the Merchants' Grocery Company building; elevation, 26.48 feet. (4) On the lower end of the third floor beam, in the second span from the left bank; elevation, 22.75 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 111; Bull 140, pp 77-78; WS 15, p 58; 27, p 59; 36, p 163; 48, p 178; 65, p 290; 83, p 188; 98, pp 248-249; 128, pp 70-71.

Discharge: Ann 18, iv, p 111; Bull 140, p 78; WS 15, p 58; 27, p 65; 36, p 163; 48, pp 178-179; 65, p 290; 83, p 188; 98, p 249; 128, p 71.

Discharge, monthly: Ann 18, iv, p 113; 19, iv, p 254; 20, iv, pp 202, 204; 21, iv, p 159; 22, iv, p 221; WS 75, p 100; 83, p 190; 128, p 73.

Discharge, yearly: Ann 20, iv, p 51.

Gage heights: Bull 140, p 78; WS 11, p 41; 15, p 58; 27, p 61; 36, p 164; 48, p 179; 65, p 291; 83, p 189; 98, pp 249-250; 128, p 72.

Hydrographs: Ann 19, iv. p 254; 20, iv, p 204; 21, iv, p 159; 22, iv, p 221.

Rainfall and run-off relation: Ann 20. iv, p 202.

Rating tables: Ann 18, iv, p 112; 19, iv, p 253; WS 39, p 445; 52, p 515; 65, p 323; 83, p 189; 128, p 72.

Discharge measurements of Greenbrier River at Alderson, W. Va., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 22	A. H. Horton	416	2,855	5.78	7.90	16,480
March 22	do	416	2,563	5.33	7.17	13,660
March 23	do	416	1,732	4.18	5.24	7,242
March 23	do	416	1,939	4.56	5.69	8,842
September 15	R. H. Bolster	326	367	.95	2.01	350

Daily gage height, in feet, of Greenbrier River at Alderson, W. Va., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	2.4	2.6	3.1	3.0	2.6	2.25	2.35	2.0	1.6	2.1	2.3
2	2.25	2.4	3.2	2.95	2.9	2.5	3.0	2.25	2.1	1.5	1.95	2.4
3	2.35	2.4	3.35	2.9	2.8	2.4	2.85	2.2	2.2	1.7	1.95	4.2
4	2.2	2.4	3.4	2.8	2.7	2.3	2.65	2.1	2.55	1.6	1.9	6.5
5	2.4	2.3	4.2	2.7	2.6	2.2	3.3	2.2	2.4	1.6	1.9	4.5
6	2.2	2.2	4.2	3.3	2.5	2.2	3.0	2.3	2.25	1.6	1.9	3.6
7	2.1	2.1	4.4	3.8	2.9	2.1	2.8	2.4	2.15	1.6	1.9	3.15
8	2.25	1.9	5.4	3.65	3.2	2.1	2.9	2.4	2.0	1.6	1.9	2.95
9	2.35	2.0	7.9	3.5	3.15	2.0	2.65	2.25	1.95	1.6	2.0	2.75
10	2.0	2.0	10.5	3.3	2.9	2.0	2.5	2.15	1.9	1.6	2.05	2.65
11	2.15	1.9	8.6	3.2	2.85	2.0	2.4	2.5	1.9	1.7	2.0	2.5
12	2.75	2.0	6.4	3.2	11.2	2.0	2.3	2.6	1.9	1.8	1.95	2.45
13	4.5	2.2	5.5	3.1	9.3	2.0	5.5	2.5	2.1	2.0	1.9	2.4
14	4.55	2.35	4.85	3.0	6.3	1.95	7.0	2.4	2.0	1.9	1.9	2.3
15	3.7	2.5	4.75	2.9	5.4	1.95	5.5	2.45	2.0	2.05	1.8	2.4
16	3.3	2.6	4.7	2.8	5.1	2.05	4.1	2.55	1.95	1.9	1.8	2.3
17	3.1	2.45	4.65	2.75	4.75	2.0	3.3	2.65	1.9	1.8	1.8	2.25
18	2.8	2.3	5.0	2.65	4.4	1.9	3.0	2.6	1.85	1.8	1.8	2.25
19	2.5	2.3	5.0	2.6	3.9	1.9	2.75	2.5	1.8	1.75	1.85	2.2
20	2.5	2.2	5.45	2.5	3.5	1.9	2.55	2.35	1.8	1.7	1.9	2.4
21	2.5	2.1	6.2	2.5	3.15	1.9	2.5	2.25	1.75	1.7	2.1	2.6
22	2.5	2.1	7.55	2.55	2.95	2.8	2.35	2.2	1.7	1.7	2.3	6.0
23	2.45	2.5	5.8	2.65	2.85	3.1	3.8	2.1	1.7	1.7	2.25	4.8
24	2.4	2.5	4.6	2.6	2.7	3.15	5.0	2.05	1.7	1.7	2.2	4.2
25	2.4	2.7	4.1	2.5	2.6	4.7	3.85	2.0	1.7	1.75	2.15	3.8
26	2.4	2.9	4.0	2.5	2.5	3.8	3.25	2.1	1.6	1.9	2.1	3.55
27	2.4	2.9	3.8	2.5	2.5	3.5	2.9	2.0	1.7	2.4	2.1	3.2
28	2.4	2.85	3.6	2.6	2.45	3.15	2.65	2.3	1.65	2.95	2.05	3.0
29	2.4	.....	3.4	3.2	2.4	2.8	2.6	2.2	1.6	2.45	2.05	2.9
30	2.4	.....	3.3	3.1	2.5	2.5	2.45	2.15	1.6	2.3	2.2	2.9
31	2.4	.....	3.2	.....	2.5	.....	2.45	2.1	.....	2.3	.....	2.9

Station rating table for Greenbrier River at Alderson, W. Va., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	43	3.20	2,261	4.90	6,403	6.60	11,725
1.50	69	3.30	2,468	5.00	6,680	6.70	12,075
1.60	103	3.40	2,680	5.10	6,960	6.80	12,425
1.70	146	3.50	2,897	5.20	7,243	6.90	12,780
1.80	199	3.60	3,119	5.30	7,529	7.00	13,140
1.90	263	3.70	3,346	5.40	7,818	7.20	13,860
2.00	340	3.80	3,579	5.50	8,112	7.40	14,600
2.10	431	3.90	3,818	5.60	8,412	7.60	15,350
2.20	537	4.00	4,062	5.70	8,718	7.80	16,120
2.30	659	4.10	4,310	5.80	9,031	8.00	16,910
2.40	798	4.20	4,561	5.90	9,350	8.20	17,710
2.50	954	4.30	4,815	6.00	9,675	8.40	18,510
2.60	1,124	4.40	5,072	6.10	10,005	8.60	19,330
2.70	1,301	4.50	5,332	6.20	10,340	8.80	20,170
2.80	1,483	4.60	5,595	6.30	10,680	9.00	21,030
2.90	1,670	4.70	5,861	6.40	11,025	9.50	23,250
3.00	1,862	4.80	6,130	6.50	11,375	10.00	25,560
3.10	2,059						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1903–1905 between gage heights 1.4 feet and 8 feet. It is well defined between these limits.

Estimated monthly discharge of Greenbrier River at Alderson, W. Va., for 1905.

[Drainage area, 1,344 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,464	340	1,256	0.935	1.08
February	1,670	263	765	.569	.592
March	27,940	1,124	7,140	5.31	6.12
April	3,579	954	1,728	1.29	1.44
May	31,440	798	4,135	3.08	3.55
June	5,861	263	1,073	.798	.890
July	13,140	598	2,598	1.93	2.22
August	1,212	340	681	.507	.584
September	1,039	103	310	.231	.258
October	1,766	69	294	.219	.252
November	659	199	347	.258	.288
December	11,380	537	2,479	1.84	2.12
The year	31,440	69	1,900	1.41	19.39

SCIOTO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Scioto River rises in the eastern part of Auglaize County, Ohio, flows eastward for about 40 miles and then almost due south, entering the Ohio at Portsmouth. Below Columbus, where it is joined by the Olentangy, it is one of the largest and most important

streams in the State. The United States Geological Survey maintains stations on both Scioto and Olentangy rivers at Columbus for the purpose of studying the water supply and sewage disposal of that city. The river has considerable fall and flows through a hilly basin, forming numerous good locations for water-power developments.

SCIOTO RIVER NEAR COLUMBUS, OHIO.

This station was originally established for the Ohio State board of health on the Grand View Avenue Bridge, 3 miles northwest of Columbus post-office, and was reestablished on the same bridge for the United States Geological Survey on November 21, 1903.

The main channel is straight for 100 feet above and 200 feet below the station, and there is a small island above, which causes a side channel to enter the main channel at this point. The banks are high and overflow only in extreme floods. The bed of the stream is of clay and coarse gravel, and fairly permanent. At low water the current is sluggish.

The bridge from which the discharge measurements are made is a two-span iron highway bridge, 250 feet between abutments. The initial point for soundings is the face of the east abutment on the downstream side, and the bridge is marked every 10 feet with double nails. At low water this river can be waded with good results below the bridge.

The gage of the United States Geological Survey has its zero at the same elevation as the gage which was established for the Ohio State board of health. It is a standard chain gage, with a length of 30.40 feet from the end of the weight to the end of the last copper link, which is used as the marker. This gage was read during 1905 by O. M. Fisher. Bench marks were established as follows: (1) The upper side of the upper angle iron forming the lowest part of the hand rail above a point 1 foot east of the pulley; elevation 34.02 feet. (2) The extreme northeast corner of the north stone of the parapet wall of the east abutment; elevation, 34.32 feet. (3) A nail in a telegraph pole 10 feet east of the east abutment at the north side; elevation, 34.95 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey. (Ann=Annual Report; WS=Water-Supply Paper.)

Description: Ann 21, iv, p 169; WS 27, p 60; 36, p 176; 49, p 219; 65, p 295; 98, p 233; 128, p 74.
Discharge: WS 36, p 177; 49, p 219; 98, p 233; 128, p 75.
Discharge, flood: Ann 20, iv, p 214.
Discharge, low-water: Ann 20, iv, p 214.
Discharge, monthly: Ann 20, iv, p 213; 21, iv, p 170; 22, iv, p 237; 128, p 76.
Gage heights: WS 27, p 65; 36, p 177; 49, p 220; 65, p 296; 98, p 234; 128, p 75.
Hydrograph: Ann 22, iv, p 237.
Rating tables: WS 39, p 446; 52, p 515; 128, p 76.

Discharge measurements of Scioto River near Columbus, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	R. W. Pratt	206	442	0.65	9.95	287
February 25	do	231	1,038	1.74	12.65	1,808
May 12	do	247	2,370	4.04	18.48	9,576
May 21	M. S. Brennan	215	752	1.77	11.58	1,332
June 18	S. K. Clapp	212	592	1.08	10.65	637
July 10	do	202	376	.85	9.92	320
August 30	R. W. Pratt	173	312	.32	9.43	101
October 14	do	205	380	.53	9.82	200
November 20[a]	do	26	13	1.15	8.99	15

[a] Made at different section.

Daily gage height, in feet, of Scioto River near Columbus, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.15	.....	15.5	9.95	12.2	10.7	9.56	9.1	9.3	11.3	10.25	11.7
2	9.95	9.5	15.1	9.8	11.7	10.5	9.5	9.91	9.4	13.2	10.1	11.3
3	9.96	.....	14.2	9.7	11.2	10.1	9.5	10.02	9.62	12.2	9.9	12.8
4	9.7	.....	13.9	9.7	10.75	10.0	9.6	9.86	9.33	11.8	9.15	12.2
5	9.65	.....	11.9	9.7	10.4	12.3	9.6	9.7	9.4	11.3	9.15	11.4
6	9.6	.....	11.4	9.68	10.22	14.6	10.1	9.8	9.3	10.9	11.9	11.2
7	9.5	.....	11.4	9.65	10.2	14.3	9.94	9.34	9.28	10.7	11.7	11.1
8	.....	.....	14.2	9.55	10.2	13.6	10.0	9.28	9.15	10.3	11.6	11.1
9	.....	.....	14.4	9.54	10.15	12.6	10.5	9.2	9.2	10.15	11.5	10.65
10	.....	.....	13.2	9.5	11.1	11.35	10.3	9.29	9.15	10.05	11.0	10.6
11	.....	9.75	12.7	10.7	11.5	11.3	10.2	9.46	9.36	9.97	10.6	10.55
12	9.3	.....	12.2	10.7	19.3	10.85	9.9	11.7	12.5	9.7	10.35	10.5
13	.....	.....	11.5	10.5	18.3	10.65	9.7	12.3	12.1	9.73	10.25	10.5
14	.....	.....	11.2	10.3	16.6	10.5	9.5	10.95	11.7	9.7	10.15	10.45
15	.....	9.8	10.9	10.2	15.5	10.3	9.4	15.2	11.15	9.8	10.1	10.4
16	.....	.....	10.8	10.0	14.0	10.1	9.96	13.9	15.0	9.73	10.05	10.4
17	.....	9.7	10.75	9.7	13.2	10.3	9.62	11.7	14.9	9.7	10.3	10.4
18	.....	.....	11.7	9.63	13.0	10.55	9.6	10.8	12.6	9.7	9.4	10.15
19	10.06	.....	11.15	9.6	12.6	11.2	9.47	10.7	12.7	10.1	9.3	10.0
20	.....	.....	11.75	9.6	12.0	12.8	9.32	11.9	13.3	11.5	8.95	9.7
21	.....	11.5	11.55	11.45	11.45	12.5	9.25	11.3	13.1	10.8	8.9	9.8
22	.....	11.3	11.4	13.3	11.0	12.3	9.26	10.7	12.1	10.5	8.9	10.3
23	.....	12.3	11.15	12.7	10.7	11.6	9.55	10.6	11.9	10.3	8.9	13.2
24	.....	11.35	10.9	12.3	10.4	11.1	9.48	10.4	11.35	10.25	8.8	12.9
25	.....	12.2	10.7	11.7	10.25	11.0	9.36	10.1	10.8	10.2	8.95	12.9
26	.....	13.0	10.5	11.2	12.5	10.47	9.31	9.83	10.7	10.15	8.9	11.45
27	9.7	14.3	10.4	10.95	11.0	10.1	9.23	9.75	10.4	10.0	8.0	10.75
28	.....	14.5	10.3	10.7	10.5	9.91	9.2	9.69	10.15	9.99	8.85	10.0
29	.....	.....	10.2	11.7	10.2	9.74	9.16	9.6	10.0	9.85	8.9	10.7
30	.....	.....	10.1	12.9	10.7	9.63	9.1	9.43	9.9	9.82	9.8	10.15
31	.....	.....	10.0	.....	10.7	.....	9.11	9.43	.....	9.85	.....	10.75

NOTE.—River frozen over January 8 to February 20, approximately. Gage heights are to water surface in hole in ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 12	9.3	9.3	0.25
January 19	10.06	10.1	.3
January 27	9.7	9.75	.4
February 2	9.5	9.65	.4
February 11	9.75	9.9	1.1
February 15	9.8	9.95	1.3
February 18	9.7	9.85	1.3

Station rating table for Scioto River near Columbus, Ohio from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
8.90	12	11.00	830	13.00	2,510	17.00	7,640
9.00	27	11.10	895	13.20	2,715	17.20	7,950
9.10	43	11.20	965	13.40	2,925	17.40	8,260
9.20	61	11.30	1,035	13.60	3,145	17.60	8,570
9.30	81	11.40	1,110	13.80	3,365	17.80	8,880
9.40	103	11.50	1,185	14.00	3,395	18.00	9,200
9.50	128	11.60	1,260	14.20	3,825	18.20	9,520
9.60	156	11.70	1,340	14.40	4,065	18.40	9,840
9.70	186	11.80	1,420	14.60	4,305	18.60	10,170
9.80	218	11.90	1,500	14.80	4,555	18.80	10,510
9.90	253	12.00	1,585	15.00	4,805	19.00	10,850
10.00	291	12.10	1,670	15.20	5,065	19.50	11,700
10.10	332	12.20	1,755	15.40	5,330	20.00	12,600
10.20	376	12.30	1,845	15.60	5,600	20.50	13,500
10.30	424	12.40	1,935	15.80	5,880	21.00	14,450
10.40	475	12.50	2,025	16.00	6,160	21.50	15,410
10.50	530	12.60	2,120	16.20	6,450	22.00	16,410
10.60	585	12.70	2,215	16.40	6,740	22.50	17,440
10.70	645	12.80	2,310	16.60	7,040	23.00	18,400
10.80	705	12.90	2,410	16.80	7,340	24.00	20,680
10.90	765						

NOTE.—The above table is applicable only for open channel conditions. It is based on 17 discharge measurements made during 1904–5. It is well defined between gage heights 9 feet and 12 feet. The table has been extended above 12 feet, being based on four measurements from 18 to 23 feet gage height

Estimated monthly discharge of Scioto River near Columbus, Ohio, for 1904-5.

[Drainage area, 1,051 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March	19,470	1,072	5,334	5.08	5.86
April	21,340	272	3,392	3.23	3.60
May	1,628	186	412	.392	.452
June	675	116	287	.273	.305
July	8,570	79	1,528	1.45	1.67
August	142	7	47.9	.046	.053
September	47	15	27.8	.026	.029
October	123	1	41.7	.040	.046
November	85	12	46.0	.044	.049
December	895	27	130	.124	.143
1905.					
January 1-7	354	128	220	.209	.054
February 21-28	4,185	1,035	2,192	2.09	.622
March	5,465	291	1,647	1.57	1.81
April	2,820	128	697	.663	.740
May	11,360	354	2,045	1.95	2.25
June	4,305	165	1,149	1.09	1.22
July	530	43	170	.162	.187
August	5,065	43	724	.689	.794
September	4,805	52	1,104	1.05	1.17
October	2,715	186	570	.542	.625
November	1,500	0	353	.336	.375
December	2,715	186	898	.854	.985

NOTE.—The estimates for 1904 are a revision of those published in the 1904 report, being based on additional data.
No estimate for frozen period.

OLENTANGY RIVER NEAR COLUMBUS, OHIO.

This station was established October 7, 1903, in connection with the water-supply and sewage-disposal investigations of the city of Columbus, Ohio. It is located 4 miles north of the Columbus post-office and one-fourth mile west of North High street, at the Dodridge street bridge.

The channel is straight for 300 feet above and 500 feet below the station. Both banks are high and overflow only at high stages. The bed of the stream is composed of sand and clay. The current is sluggish.

Discharge measurements are made from the two-span highway bridge 200 feet long and by wading below the bridge. The initial point for soundings is the east face of the west parapet wall.

A standard chain gage is bolted to the hand rail of the bridge on the upstream side; length of the chain from the end of the weight to the marker, 36.15 feet. The gage was read during 1905 by A. D. Winegardner. The gage is referred to bench marks as follows: (1) The northwest corner of the topstone of the north wing of the west abutment; elevation, 34.99 feet. (2) A cut in the top of the hand rail over the gage 31 feet from the initial point for soundings; elevation, 39.89 feet. (3) The center pin of the west end of the north truss; elevation, 38.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 27, p 60; 36, p 175; 49, p 218; 65, p 295; 98, pp 234-235; 128, p 77.
Discharge: WS 27, p 65; 36, p 175; 49, pp 218-219; 98, p 235; 128, p 77.
Discharge, low water: Ann 20, iv, p 215.
Discharge, monthly: Ann 20, iv, p 216; 21, iv, p 169; 22, iv, p 238; 128, p 79.
Gage heights: WS 27, p 65; 36, p 176; 49, p 219; 65, p 295; 98, p 235; 128, p 78.
Hydrograph: Ann 22, iv, p 238.
Rainfall and run-off relation: Ann 20, iv, p 216.
Rating tables: WS 39, p 446; 52, p 515; 128, pp 78-79.

Discharge measurements of Olentangy River near Columbus, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	R. W. Pratt	140	571	0.30	7.15	169
May 13	do	170	1,308	2.88	11.98	3,865
May 20	M. S. Brennan	150	699	1.18	8.24	823
June 19	S. K. Clapp	150	763	1.25	8.50	951
August 23	R. W. Pratt	138	561	.43	7.32	244
October 26	do	138	527	.35	7.10	180
November 7	do	141	676	1.04	8.10	704

Daily gage height, in feet, of Olentangy River near Columbus, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.2	.....	9.2	7.0	7.6	8.8	6.7	6.6	6.7	6.8	7.1	8.7
2	7.2	.....	8.6	6.9	7.2	7.7	6.8	7.0	6.7	7.5	7.1	8.7
3	7.0	.....	8.4	6.9	7.2	7.4	6.7	6.8	6.8	7.9	7.1	8.9
4	6.9	.....	8.2	6.9	7.2	7.2	6.7	6.7	6.8	7.4	7.0	8.7
5	6.9	6.4	7.8	6.9	7.0	9.1	8.2	6.6	6.8	7.2	6.9	8.7
6	6.9	.....	7.9	6.9	7.0	9.5	7.9	6.6	6.6	7.1	8.2	7.3
7	6.9	.....	8.0	6.9	7.0	8.1	7.3	6.6	6.6	6.9	8.1	7.3
8	6.8	.....	11.0	6.8	7.0	7.9	7.0	6.6	6.6	6.8	7.9	7.2
9	.....	.....	10.7	6.8	7.0	7.5	7.2	6.55	6.6	6.7	7.6	7.1
10	.....	.....	8.9	6.8	6.9	7.3	7.0	6.6	6.6	6.3	7.5	7.0
11	.....	.....	8.0	7.9	8.2	.....	7.1	6.5	8.1	6.7	7.2	7.0
12	6.9	6.8	8.2	7.5	14.6	.....	6.9	8.5	10.0	6.7	7.1	7.0
13	7.2	6.9	7.8	7.5	13.6	.....	6.8	8.6	8.5	6.8	7.0	6.9
14	8.2	.....	7.6	7.2	12.5	.....	6.8	7.6	7.8	6.8	7.0	6.9
15	7.6	.....	7.5	7.1	10.9	7.1	6.8	11.3	7.4	6.8	6.9	6.8
16	7.4	.....	7.4	6.9	9.7	7.1	7.0	10.6	10.6	6.8	6.9	6.9
17	7.3	6.8	7.6	6.9	9.6	8.6	6.8	10.6	11.0	6.8	6.9	6.9
18	.....	.....	7.9	6.9	9.0	8.6	6.7	10.2	10.4	6.7	6.9	6.9
19	.....	.....	8.3	6.9	8.8	8.0	6.7	8.9	9.6	6.9	6.9	6.9
20	.....	.....	10.0	6.9	8.4	7.4	6.6	9.0	10.4	8.2	6.9	6.8
21	7.2	7.0	9.7	9.6	7.9	7.7	6.6	8.4	9.1	8.0	6.9	8.4
22	6.9	7.75	8.8	10.0	7.6	10.5	6.6	7.7	8.6	7.5	6.9	9.6
23	6.8	7.8	8.2	9.1	7.4	9.0	6.6	7.3	7.4	7.2	6.8	9.7
24	6.8	7.6	7.9	8.1	7.2	8.1	6.6	7.1	7.4	7.1	6.8	8.8
25	6.8	8.4	7.6	7.6	7.1	7.6	6.6	7.0	7.3	7.1	6.9	7.8
26	.....	9.0	7.5	7.5	9.4	7.3	6.6	7.0	7.1	7.0	6.9	7.6
27	.....	9.35	7.4	7.6	10.2	7.0	6.6	6.9	7.0	7.0	6.9	7.4
28	.....	9.6	7.3	7.3	8.8	6.9	6.6	6.9	7.0	6.9	6.9	7.3
29	.....	.....	7.2	7.9	7.9	6.8	6.6	6.7	6.9	6.9	7.7	7.2
30	6.4	.....	7.1	8.0	8.1	6.8	6.6	6.7	6.9	6.9	8.1	7.8
31	.....	.....	7.0	.....	9.2	.....	6.6	6.7	.....	6.8	.....	8.0

NOTE.—Ice conditions January 1 to March 7 approximately.

Station rating table for Olentangy River near Columbus, Ohio, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.30	1	8.00	600	9.70	1,790	11.80	3,740
6.40	3	8.10	660	9.80	1,870	12.00	3,950
6.50	5	8.20	720	9.90	1,950	12.20	4,170
6.60	13	8.30	780	10.00	2,030	12.40	4,390
6.70	28	8.40	840	10.10	2,120	12.60	4,620
6.80	53	8.50	910	10.20	2,210	12.80	4,860
6.90	83	8.60	980	10.30	2,300	13.00	5,100
7.00	115	8.70	1,050	10.40	2,390	13.20	5,340
7.10	152	8.80	1,120	10.50	2,480	13.40	5,580
7.20	192	8.90	1,190	10.60	2,570	13.60	5,820
7.30	235	9.00	1,260	10.70	2,660	13.80	6,060
7.40	280	9.10	1,330	10.80	2,750	14.00	6,300
7.50	327	9.20	1,400	10.90	2,840	14.20	6,560
7.60	375	9.30	1,470	11.00	2,940	14.40	6,820
7.70	425	9.40	1,550	11.20	3,140	14.60	7,080
7.80	480	9.50	1,630	11.40	3,340	14.80	7,340
7.90	540	9.60	1,710	11.60	3,540	15.00	7,600

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1904–5. It is well defined between gage heights 6.5 feet and 8 feet. The table has been extended above 8 feet, being based on one measurement at 19.4 feet. Above 7.7 feet the table is the same as for 1904.

Estimated monthly discharge of Olentangy River near Columbus, Ohio, for 1905.

[Drainage area, 520 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 8–31	2,940	115	798	1.53	1.36
April	2,030	53	364	.700	.781
May	7,080	83	1,236	2.38	2.74
June 1–10, 15–30	2,480	53	601	1.16	1.12
July	720	13	91.2	.175	.202
August	3,240	5	572	1.10	1.27
September	2,940	13	675	1.30	1.45
October	720	1	155	.298	.344
November	720	53	201	.387	.432
December	1,790	53	492	.946	1.09

NOTE.—No estimate for frozen period.

LITTLE MIAMI RIVER BASIN.

DESCRIPTION OF BASIN.

Little Miami River rises in the southeastern part of Clark County, flows southwest through Greene and Warren counties, and enters Ohio River just above Cincinnati. The greater part of the drainage area lies to the east, as there is only a narrow piece of country between this and Miami River. The Little Miami is the best power river in the State of Ohio.

MAD RIVER NEAR SPRINGFIELD, OHIO.

This station was established December 31, 1903. It is located at the highway bridge 4 miles west of Springfield, Ohio, about 500 feet below the old Red Mill dam. The drainage area of Mad River at this station is 290 square miles.

The channel is practically straight for 1,000 feet above and below the station, there being a slight curve just above. The right bank is high, clean, and seldom overflows. The left bank is rather low and is subject to overflow. The bed of the stream is composed of a mixture of clay and gravel and is fairly permanent. The current is swift.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is fastened. The bridge has a length between abutments of 128 feet. The initial point for soundings is a cut in the guard timber directly over the face of the south abutment, downstream side.

A standard chain gage is spiked to the bridge; length of the chain, from the end of the weight to the marker, 16.05 feet. The gage was read during 1905 by Charles W. Smith and Samuel Taylor. The gage is referred to bench marks as follows: (1) On the extreme west corner of the second step-stone on the upstream side of the north side of the bridge; elevation, 15.88 feet. (2) The inside surface of the bottom of the gage box; elevation, 19.67 feet. (3) A nail in the top of the lower chord 87 feet from the initial point; elevation, 18.69 feet. Elevations refer to datum of the gage.

Description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 80–81.

Discharge measurements of Mad River near Springfield, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 12 [a]	R. W. Pratt	165	926	0.57	6.63	527
February 27 [a]	do	125	935	.80	6.97	750
March 23 [a]	do	108	830	.39	6.13	326
May 20	M. S. Brennan	117	430	1.90	6.64	818
June 18	Sidney K. Clapp	113	350	.97	6.00	341
July 11	do	111	330	.85	5.92	279
August 24 [a]	R. W. Pratt	103	699	.34	5.86	234
August 24	do	111	321	.81	5.87	259
October 11 [a]	do	105	744	.47	6.18	351
November 11 [a]	do	105	702	.43	6.15	300

[a] Made at different sections.

Daily gage height, in feet, of Mad River near Springfield, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.8	5.7	7.75	5.95	6.3	6.6	6.1	5.7	5.7
2	5.75	5.75	7.8	5.9	6.1	6.3	6.1	5.7	7.3
3	5.75	5.8	6.74	5.9	6.1	6.1	6.1	5.7	6.2
4	5.8	5.75	6.5	5.8	6.3	6.0	6.4	5.7	6.0
5	5.8	.....	6.2	5.8	6.2	11.6	6.1	5.6	5.8
6	5.85	.....	6.25	5.8	6.1	9.9	6.0	5.7	5.8
7	5.8	.....	6.5	5.8	6.1	8.7	6.1	5.7	5.8
8	5.6	.....	8.6	5.9	6.05	7.1	6.1	5.7	5.8
9	5.65	.....	7.4	5.8	6.0	6.8	6.0	5.7	5.7
10	5.65	.....	6.9	5.75	5.9	6.4	6.0	5.6	6.0
11	5.5	5.75	6.6	7.6	6.5	6.4	5.9	5.8	6.6
12	6.5	.....	6.4	6.5	6.8	6.3	6.3	6.2	6.3
13	6.3	.....	6.3	6.5	10.9	6.2	6.0	6.0	6.0
14	6.1	.....	6.25	6.35	8.9	6.1	6.0	6.1	5.9
15	6.5	.....	6.25	6.15	8.6	6.1	5.9	6.7	5.8
16	6.5	.....	6.2	6.1	8.9	6.2	5.9	6.9	9.3
17	6.2	.....	6.2	6.0	7.6	6.1	5.8	6.2	7.4
18	5.8	5.8	6.15	5.9	7.2	6.0	5.8	6.4	7.0
19	5.8	7.5	6.3	6.0	7.0	6.0	5.8	6.9	7.8
20	5.8	.....	6.45	6.7	6.7	6.2	5.9	6.9	7.5
21	5.75	.....	6.3	6.9	6.5	6.9	5.8	6.2	6.7
22	5.75	6.35	6.25	6.9	6.2	6.5	5.8	6.0	6.4
23	5.75	6.35	6.2	6.7	6.2	6.2	5.8	5.9	6.2
24	5.4	6.1	6.2	6.5	6.1	6.1	5.8	5.9	.....
25	6.0	6.8	6.15	6.4	6.1	6.0	5.7	5.9	.....
26	5.8	8.2	6.1	6.1	6.5	6.3	5.7	5.8	.....
27	5.7	7.3	6.05	6.15	6.2	6.1	5.7	5.8	.....
28	5.7	7.85	6.5	6.1	6.1	6.0	5.7	5.7	.....
29	5.75	.....	6.0	7.8	6.2	5.9	5.7	5.7	.....
30	5.8	.....	5.95	6.8	7.8	5.9	.....	5.7	.....
31	5.75	.....	5.9	.....	7.0	.....	.....	5.7	.....

MIAMI RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Miami furnishes the main drainage system of southwestern Ohio. Exclusive of the Whitewater, it has a drainage area of nearly 4,000 square miles, or about one-tenth of the State of Ohio. Its headwaters are at the continental water-shed, and it drains the greater part of the Cincinnati arch from that watershed south to Ohio River. One of the eastern tributaries, Mad River, heads in the elevated tract near Bellefontaine, at an elevation of fully 1,200 feet above tide. The other headwaters, except the Whitewater, have their sources at an elevation of about 1,000 feet. The Whitewater, as noted above, rises in the higher part of eastern Indiana, at an elevation of nearly 1,200 feet.

The valleys of the headwaters as far down as the vicinity of Dayton are narrow and comparatively shallow post-Glacial channels, with courses independent of pre-Glacial drainage lines. Mad River, it is true, occupies a broad trough-like valley, but on its borders are moraines which cause most of the relief, the bluffs being generally but 20 or 30 feet high. Below Dayton the Miami and some of its tributaries occupy pre-Glacial lines which are only partially filled with glacial deposits. The work of the present streams has been in the main a reexcavation of the valleys. In this work they have fallen far short of reaching the old rock floors which lie 100 to 200 feet below their beds. The depth of this reexcavation is but 50 to 100 feet, and the width is but a small fraction of that of

the old valley, seldom so much as one-fourth as great. The contrast between the southern and the northern portion of this drainage basin, therefore, is not found in the work of the present streams, but is due to the less complete concealment of pre-Glacial drainage lines.

The fall of the Miami is rapid throughout its entire length, being seldom less than 3 feet and usually over 4 feet per mile. The streams in this drainage system seldom reach a very low stage in seasons of drought for the valleys are usually filled with gravelly or sandy deposits which furnish strong springs. Even in the small tributaries water-bearing beds outcrop along the banks or bluffs.

This stream and several of its tributaries afford valuable water power, the utilization of which is discussed by Prof. Dwight Porter in the Tenth Census Report.[a] From this report it appears that a total of 9,431 horsepower was used in 1880 by 290 mills, manufactories, etc., on the Miami and its tributaries, including Whitewater River.

The following pages contain the results of stream-measurement data collected by the United States Geological Survey in the drainage basin of Miami River.

MIAMI RIVER AT DAYTON, OHIO.

This station was established March 18, 1905. It is located at the Miami Street Bridge, Dayton, Ohio, about one-half mile below the mouth of Mad River. There is a dam 1 mile above the station which may divert water through a canal and discharge it 1,000 feet below the gaging section. There is also a dam on Mad River 2½ miles above the station, where water is diverted into the Miami canal.

The channel is straight for 1,000 feet above and nearly so for 1,000 feet below the station. Both banks are high, diked, and are not subject to overflow. The bed of the stream is composed of gravel and silt. All the water passes between the abutments of the bridge, except as diverted through the canals as noted above. The former canal is rarely used. The current is sluggish at low water.

Discharge measurements are made from the upstream side of the steel-concrete bridge to which the gage is attached. The bridge consists of seven spans of about 76 to 100 feet each, having a total length of 592 feet. The initial point for soundings is a standard bench-mark tablet of the topographic branch of the United States Geological Survey marked "755," embedded in the concrete masonry forming the extreme south end of the guard rail, upstream side.

The gage consists of a vertical staff graduated to feet and tenths, spiked to the downstream end of the first pier from the left bank. The gage is referred to bench marks as follows: (1) The top of the rail at the Union Station; elevation, 13.00 feet. (2) The top of the southwest corner of the lower masonry course of the soldiers' monument directly south of the bridge; elevation, 24.86 feet. (3) The United States Geological Survey standard bench mark, described as initial point for soundings; elevation, 30.80 feet. Elevations refer to the datum of gage. During 1905 the gage was read by D. D. Rist, the United States Weather Bureau observer.

Discharge measurements of Miami River at Dayton, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 18	R. W. Pratt	406	1,600	0.96	2.15	1,534
May 19	M. S. Brennan	443	1,878	2.37	3.53	4,455
June 17	Sidney K. Clapp	373	1,093	.88	1.60	967
July 11	do	359	897	.69	1.10	618
August 25	R. W. Pratt	382	1,630	1.06	2.45	1,712
October 12	do	377	1,257	.57	1.55	713
November 18	do	385	1,198	.56	1.48	665

[a] Tenth Census of United States, 1880, Vol. XVII, pp. 478–487.

Daily gage height, in feet, of Miami River at Dayton, Ohio, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	3.3	2.6	1.2	0.7	1.1	17	1.4	4.4	1.6	0.8	3.8	4.6
2	.....	2.8	2.3	1.6	.6	1.0	18	1.3	4.0	1.5	.9	3.0	5.0
3	.....	2.4	2.0	1.7	.6	1.8	19	1.2	3.6	1.5	.9	2.5	5.1
4	.....	2.1	1.9	1.7	.6	1.5	20	1.2	3.2	1.6	1.0	2.7	5.0
5	.....	2.0	1.8	1.5	.6	1.4	21	1.8	2.9	2.2	1.0	3.0	4.1
6	.....	1.8	3.9	1.4	.5	1.1	22	4.7	2.5	2.4	.9	2.8	3.3
7	.....	2.0	3.8	1.2	.5	1.0	23	3.5	2.2	2.0	.9	2.4	2.9
8	.....	1.8	3.0	.9	.7	1.0	24	3.0	2.0	1.8	.8	2.1	2.5
9	.....	1.6	2.5	1.0	.6	1.0	25	2.5	1.9	1.7	.8	2.4	2.2
10	.....	1.5	2.2	1.0	.6	.9	26	2.3	1.9	1.4	.8	2.0	1.9
11	.....	1.2	2.1	.9	.9	1.1	27	2.2	1.9	1.6	.8	1.8	1.8
12	.....	9.3	2.0	1.0	1.1	3.7	28	2.2	1.8	1.4	.8	1.6	1.6
13	.....	9.0	1.8	1.2	1.0	4.8	29	3.8	1.7	1.3	.8	1.4	1.5
14	.....	6.2	1.7	1.1	1.5	3.4	30	3.5	3.8	1.2	.7	1.2	1.4
15	.....	5.8	1.6	1.0	1.5	3.0	31	.....	3.2	.....	.7	1.1	.....
16	1.6	5.0	1.6	.9	4.0	2.8							

KENTUCKY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kentucky River drains into the Ohio from the south about halfway between Cincinnati, Ohio, and Louisville, Ky. The following pages contain the results of stream-measurement data collected in the Kentucky River drainage by the United States Geological Survey during 1905.

KENTUCKY RIVER AT FRANKFORT, KY.

This station was established March 18, 1905. It is located at the Government dam on the Kentucky River in the lower part of Frankfort, Ky., about 1 mile below the city highway bridge.

The channel is straight for 1,000 feet above and below the bridge. Both banks are high, rocky, covered with buildings, and do not overflow. The bed of the stream consists of rock, gravel, and sand and is free from vegetation and permanent. The water is approximately 15 feet deep and flows in one channel at all stages. The current is swift at high and very sluggish at low stages.

The discharge is determined by computations of the flow over the crest of the dam at low and moderate stages, the flood discharge being obtained by current-meter measurements from the single span city highway bridge. Good results should be obtained for gage heights above 8 feet. The initial point for soundings is the outside face of the first hand-rail post on the upstream side of the bridge at the right bank.

The lower portion of the gage is painted on the masonry walls of the locks at the left end of the dam, and the upper portion consists of staffs set firmly into the riprap on the left bank. During 1905 the gage was read by Mrs. C. H. McCrackin. The zero of the gage is 5.80 feet below the crest of the dam. No bench marks were established for the gage at the dam, which is maintained by the United States Army engineers. A bench mark is placed on the top of their hand rail at 40 feet from the initial point for soundings, marked with a cross in paint; elevation, 46.93 feet above the water surface when the gage at the locks read 7.40 feet.

Daily gage height, in feet, of Kentucky River at Frankfort, Ky., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.3	8.3	6.5	7.5	6.2	6.2	5.5	6.9	9.6
2	.....	7.1	7.9	6.4	7.0	6.0	6.4	5.5	6.7	9.7
3	.....	7.0	7.5	6.4	6.9	6.0	6.8	5.55	6.6	10.3
4	.....	6.9	7.2	6.3	7.1	6.0	6.7	5.6	6.5	11.0
5	.....	6.9	7.1	6.2	7.2	6.0	7.2	5.55	6.4	10.7
6	.....	7.0	6.9	6.1	6.8	6.0	7.0	5.4	6.3	10.3
7	.....	7.3	6.8	6.0	6.5	6.0	6.6	5.3	6.3	9.0
8	.....	7.4	6.7	6.0	6.5	6.0	6.4	5.2	6.2	8.0
9	.....	7.4	6.6	5.9	6.7	5.95	6.2	5.2	6.2	7.4
10	.....	7.3	7.4	5.8	7.3	5.9	6.2	5.2	6.15	7.3
11	.....	7.5	7.2	5.8	6.9	6.7	6.2	5.2	6.1	7.2
12	.....	7.4	7.4	6.4	7.3	6.6	6.4	5.25	6.1	7.0
13	.....	7.3	8.3	6.1	6.8	6.8	6.5	5.9	6.0	6.9
14	.....	7.1	9.0	6.1	6.5	7.0	6.4	7.0	5.9	6.8
15	.....	7.0	10.7	6.4	6.3	6.9	6.3	7.3	5.9	6.8
16	.....	6.9	10.4	6.5	6.6	6.8	6.3	6.9	5.9	8.3
17	.....	6.9	9.4	6.4	6.6	7.0	6.3	6.5	5.9	9.3
18	7.4	6.8	8.9	6.2	6.4	6.7	6.3	5.9	5.9	9.2
19	7.2	6.7	9.1	6.1	6.2	6.5	6.2	6.3	6.0	8.6
20	7.1	6.6	8.7	6.1	6.2	6.3	6.1	6.3	6.0	8.1
21	8.8	6.5	8.0	6.4	6.0	6.1	6.0	6.2	5.9	8.9
22	11.3	6.6	7.5	6.5	8.7	6.2	5.9	6.9	5.9	10.0
23	10.5	6.7	7.1	6.4	8.1	9.0	5.85	7.4	5.9	9.4
24	9.6	6.8	6.8	7.2	8.0	8.0	5.8	7.0	5.9	9.1
25	8.9	6.8	6.7	8.3	8.8	7.2	5.7	6.8	6.1	8.7
26	8.6	6.7	6.5	8.35	8.2	7.2	5.55	8.2	6.1	8.3
27	8.3	6.7	6.5	8.3	7.4	7.2	5.5	8.8	6.0	8.0
28	7.8	6.7	6.5	8.1	6.8	6.8	5.45	8.3	6.0	7.7
29	7.5	7.5	6.4	8.8	6.6	6.5	5.4	7.8	10.6	7.5
30	7.4	8.4	6.6	8.3	6.4	6.3	5.4	7.5	10.3	7.3
31	7.4	.....	6.9	.....	6.3	6.2	.....	7.2	.....	7.2

DICKS RIVER NEAR DANVILLE, KY.

This station was established March 18, 1905. It is located at the Danville city waterworks dam, about 5 miles east of the city of Danville.

Discharge measurements are computed by formula from the depth of water on the crest of the dam. Length of crest, 150 feet up to gage height 1.0 foot. Above 1.0 foot the crest is 200 feet long. The initial point for soundings is the crest of the dam.

The gage consists of a 2 by 4 inch pine stick nailed to a small sycamore tree about 100 feet above the above-mentioned dam on the left bank of the stream. Its zero is referred to the crest of the dam, which is said to be perfectly level. The gage was read during 1905 by Anton Rehm, the engineer of the waterworks.

Daily gage height, in feet, of Dicks River near Danville, Ky., for 1905.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1	0.41	0.10	0.19	0.06	12	0.4	0.5	0.16	0.4	22	0.23	0.25	2.0	0.05
2	.36	.08	.18	.05	13	.35	.24	.13	.7	23	.20	.9	.7	.09
3	.3	.06	.48	.04	14	.35	.18	.1	.42	24	.18	.75	.5	1.98
4	.25	.04	.45	.03	15	.45	.22	.09	.31	25	.15	.8	.47	.88
5	.24	.03	.29	.02	16	.46	.19	.11	.5	26	.14	.55	.32	1.21
6	.23	.02	.22	.02	17	.48	.17	.1	.32	27	.13	.42	.22	.....
7	.23	.02	.2	.01	18	.45	.15	.8	.2	28	.45	.32	.15	.....
8	.26	.01	.25	.21	19	.4	.14	.7	.14	29	.26	.25	.11	.....
9	.25	.01	.21	.26	20	.35	.15	.6	.11	30	.21	.22	.09	.....
10	.25	.01	.2	.22	21	.26	.14	.5	.06	31	.15	.....	.07	.....
11	.55	.02	.21	.22										

SALT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Salt River drains into the Ohio from the south about 20 to 30 miles below Louisville, Ky. The following pages contain the results of data collected by the United States Geological Survey in Salt River drainage basin during 1905:

ROLLING FORK OF SALT RIVER AT NEW HAVEN, KY.

This station was established June 16, 1905. It is located on the only two-span steel railroad bridge in New Haven, Ky., about one-fourth mile from the business section of the city.

The channel is straight for 500 feet above and 800 feet below the station. The right bank is arable above the station and is low, with a small growth of trees. Below the station it is high and steep. This bank is liable to overflow above the station. The left bank is high at the bridge, but just below the bridge it is low and subject to overflow. The bed of the stream is composed of solid rock and will not shift. There is generally one channel, except at very high stages, when there will be two. The current is swift.

At low water, measurements are made by wading just below the bridge; at medium water a boat will be used at the ford way 300 feet below the bridge. At extreme high water the steel highway bridge about 1 mile above will be used. The initial point for soundings will vary as the position of the measurements may vary according to the stage of the river.

A standard chain gage is located on the ties of the downstream side of the downstream guard rail near the middle of the left span of the bridge; length of the chain, 30.09 feet.

Discharge measurements of Rolling Fork of Salt River at New Haven, Ky., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 16	S. K. Clapp	75	77	1.78	1.41	137
October 17	M. S. Brennan	43	38	.33	1.26	12.5

Daily gage height, in feet, of Rolling Fork of Salt River at New Haven, Ky., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.4	1.2	1.0			7.0
2		1.2	1.2	1.0			4.8
3		1.25	1.1	1.0			6.7
4		1.2	1.1	1.0			8.1
5		1.1	1.1	1.0			3.9
6		1.4	1.0	1.0			2.6
7		1.6	1.3	1.0			2.3
8		1.4	1.1	1.0			2.0
9		1.8	1.1	1.1			1.9
10		4.5	1.1	1.1	0.8		
11		5.2	1.3	1.0			1.7
12		3.7	1.2	1.0			1.6
13		2.3	1.5				1.6
14		2.2	1.5				1.4
15		1.8	1.4				2.4
16			1.4				4.95
17	1.0	1.5	1.4				
18	.9	1.3	1.5				3.3
19	.8	1.3	1.2				2.95
20		1.2	1.3				2.3
21	2.05	4.1	1.2				6.0
22	3.0	3.8	1.2				9.8
23	1.9	2.4	1.2				8.8
24	1.8	3.0	1.2				
25		2.2	1.1	1.0	.6		
26	1.6	1.9	1.1				3.1
27	1.6	1.7	1.1				2.3
28	1.3	1.6	1.0	.9			
29	1.3	1.5	1.0			7.2	
30	1.3	1.4	1.0			9.8	
31		1.3	1.0				

WABASH RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The drainage basin of the Wabash embraces an area of about 33,000 square miles, distributed as follows: In Ohio, 400 square miles; in Indiana, 24,350 square miles; in Illinois, 8,250 square miles. It drains, therefore, slightly more than two-thirds of Indiana, the area of the State being 35,910 square miles. Of the portion in Indiana, about one-half is embraced in the drainage areas of East and West White rivers. By including these drainage areas with the Wabash, the entire basin has nearly symmetrical, broadly ovate form. Not including the White River system, the Wabash basin is an unsymmetrical, elongated tract, curving around White River.

The length of the valley occupied by the Wabash is about 450 miles, but the length of the stream is fully 500 miles, for the river in its lower course makes several oxbow curves within the valley. The source of the river is about 1,000 feet above tide, while its mouth at low water is but 311 feet. The average fall, if we estimate the stream to have a length of 500 miles, is therefore about 16.5 inches per mile. The rate of descent is far from uniform, being much more rapid in the upper portion than in the lower. There are also many rapids, separated by pools or sluggish portions of the stream. The elevation of the stream is accurately determined at many points, but in the absence of a careful measurement of the length of the stream the rate of fall is only approximately known. The section above the point where the river enters the old lake outlet, estimated to have a length of 100

miles, has a fall of about 300 feet, or 3 feet per mile. Railway levels and canal surveys, at the point where the river joins the old lake outlet, show its elevation to be nearly 700 feet above sea level, the altitudes reported varying between 696 and 699 feet.

The following table gives the elevation and fall at various points:

Table of altitudes and distances along Wabash River.

Location.	Estimated distance.	Altitude.	Fall per mile.
	Miles.	*Feet.*	*Inches.*
Source	0.0	1,000.0	0.0
Huntington	100.0	699.0	36.0
Mouth of Salamonie River	15.0	667.0	25.6
Mouth of Mississinewa River	20.0	633.0	20.4
Logansport	20.0	583.0	30.0
Lafayette	50.0	506.0	18.5
Attica	25.0	487.0	9.1
Covington	20.0	470.0	10.2
Terre Haute	55.0	447.7	4.9
State Line	14.6	440.6	5.8
Hutsonville, Ill	29.0	424.6	6.6
Vincennes	46.4	398.8	6.7
Mouth of White River	32.5	376.5	8.2
Grayville, Ill	28.0	365.0	4.9
Mouth of Little Wabash River	46.0	323.0	11.0
Mouth of Wabash River	16.0	311.0	9.0

WABASH RIVER AT LOGANSPORT, IND.

This station was established April 27, 1903. It is located at the Cicott Street Bridge, about 1 mile from the center of the city of Logansport, Ind., 1¾ miles from the Wabash Railroad station, 1½ miles from the Pennsylvania station, four blocks from the street-car line, and 1,000 feet below the mouth of Eel River. The drainage area of Wabash River is 3,163 square miles at Logansport, below the mouth of Eel River.

The channel is nearly straight for 1,000 feet above and 1,500 feet below the station. The distance between abutments is 550 feet and the channel is broken by three bridge piers. The right bank is high and is not subject to overflow at the bridge. The left bank is submerged only at extreme high water. The bed of the stream consists of solid rock covered with small bowlders, and is rough and permanent. The stream is shallow and is never very sluggish.

Discharge measurements are made from the upstream side of the bridge, to which the gage is attached. The initial point for soundings is the face of the left abutment.

A standard chain gage is placed on the second span of the bridge, at the third panel from the second pier, between the lower chord bars, and is supported by the bridge pins. It is reached through a trap door in the floor planks of the bridge. The length of the chain is 20.78 feet. The gage was read during 1905 by W. R. Allison. The gage is referred to bench marks as follows: (1) The top of the north abutment, under the fourth board of the downstream sidewalk; elevation above gage datum, 18.81 feet. From Pennsylvania Railroad levels its elevation above sea level has been found to be 591 feet. (2) The top of the third course of masonry from the top of the north abutment; elevation above the zero of the gage, 15.31 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, p 225; 128, pp 83-84.
Discharge: 98, p 225; 128, p 84.
Discharge, monthly: 98, p 227; 128, p 86.
Gage heights: 98, p 226; 128, p 85.
Rating table: 98, p 226; 128, p 85.

Discharge measurements of Wabash River at Logansport, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	S. K. Clapp	509	1,908	2.86	3.75	5,450
May 27	M. S. Brennan	496	1,072	1.59	2.22	1,700
June 14	S. K. Clapp	513	1,961	2.80	3.79	5,480
July 14	do	487	1,275	1.93	2.75	2,436
August 23	M. S. Brennan	494	925	1.25	1.95	1,160
September 4	do	488	767	.98	1.74	748

Daily gage height, in feet, of Wabash River at Logansport, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.95	.....	6.12	4.82	4.25	3.14	1.67	1.4	1.63	1.48	1.6	4.5
2	2.42	.....	5.88	4.25	3.7	2.88	1.7	1.4	1.72	1.55	1.63	4.05
3	2.2	2.15	5.55	3.45	3.2	2.7	1.7	1.36	1.75	1.6	1.58	3.68
4	2.0	.....	5.2	2.93	2.68	2.52	1.62	1.25	1.75	1.65	1.55	3.6
5	1.9	.....	4.6	2.6	2.55	2.4	1.62	1.35	1.6	1.89	1.6	3.5
6	1.85	.....	4.35	2.4	2.8	5.1	1.63	1.58	1.55	1.87	2.0	3.1
7	1.9	.....	3.95	2.28	3.4	4.0	1.63	2.45	1.5	1.8	2.35	2.84
8	.....	.....	3.7	2.2	3.39	3.55	1.63	2.17	1.45	1.75	2.5	2.58
9	.....	2.1	3.85	2.15	2.95	3.22	1.63	1.8	1.42	1.65	2.39	2.48
10	.....	.....	4.0	2.1	2.73	3.23	1.7	1.7	1.42	1.6	2.33	2.4
11	.....	.....	3.86	2.05	3.8	3.78	2.25	1.53	1.5	1.6	2.2	2.3
12	2.7	.....	3.6	2.05	10.5	3.78	3.17	1.45	1.49	1.54	2.05	2.25
13	.....	.....	3.1	2.05	10.05	3.8	2.95	1.4	3.33	1.5	1.85	2.22
14	.....	.....	2.85	2.0	8.45	3.72	2.63	1.49	3.48	1.5	1.81	2.15
15	.....	.....	2.7	2.0	7.1	3.33	2.4	1.77	2.9	1.45	1.8	2.1
16	.....	2.2	2.5	1.95	6.12	3.0	2.3	1.9	2.83	1.42	1.78	1.99
17	.....	.....	2.85	1.9	5.1	2.85	2.1	1.7	3.58	1.4	1.75	2.1
18	3.0	.....	3.4	1.86	4.5	2.68	1.92	2.3	4.42	2.13	1.7	2.05
19	.....	.....	3.6	1.86	3.88	2.65	1.91	2.56	3.78	2.45	1.7	2.0
20	.....	.....	3.6	1.88	3.5	2.6	1.75	2.7	3.28	2.3	1.65	1.9
21	.....	.....	3.71	5.65	3.23	2.4	1.99	2.43	3.0	2.2	1.58	2.8
22	.....	.....	3.47	6.45	2.85	2.72	1.73	2.21	2.8	2.05	1.55	4.65
23	.....	2.23	3.1	5.98	2.6	2.6	1.68	1.99	2.0	2.0	1.63	4.58
24	.....	.....	3.0	5.15	2.45	2.3	1.5	2.0	2.2	1.85	1.62	4.1
25	2.25	.....	3.58	4.48	2.3	2.19	1.5	2.57	2.0	1.8	1.59	3.6
26	.....	.....	3.45	3.75	2.25	2.19	1.43	2.6	1.8	1.78	1.6	3.2
27	.....	7.9	2.95	4.65	2.2	2.15	1.4	2.3	1.8	1.7	1.58	2.9
28	.....	6.45	2.65	4.12	2.15	2.0	1.37	1.98	1.7	1.65	1.93	2.63
29	.....	.....	2.45	5.55	2.1	1.88	1.4	1.82	1.55	1.6	5.8	2.6
30	.....	.....	2.5	4.95	2.25	1.78	1.4	1.72	1.5	1.53	6.1	2.75
31	.....	.....	5.32	.....	2.61	.....	1.43	1.55	.....	1.6	.....	3.0

NOTE.—Gage heights interpolated March 2, 9, November 16, and December 7. Ice conditions January 1 to February 27. From January 12 to February 27 river was frozen entirely across. Gage was read to the surface of the water in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 12	2.7	2.65	0.4
January 18	3.0	(a)	.7
January 25	2.25	2.3	.8
February 3	2.15	2.25	.95
February 9	2.1	2.15	1.0
February 16	2.2	2.3	1.0
February 23	2.23	2.25	1.1

a Water overflows ice.

Station rating table for Wabash River at Logansport, Ind., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	330	2.30	1,805	3.40	4,440	4.50	7,700
1.30	360	2.40	2,010	3.50	4,715	4.60	8,020
1.40	420	2.50	2,225	3.60	4,995	4.70	8,340
1.50	510	2.60	2,445	3.70	5,280	4.80	8,670
1.60	630	2.70	2,675	3.80	5,570	4.90	9,000
1.70	770	2.80	2,910	3.90	5,865	5.00	9,340
1.80	920	2.90	3,150	4.00	6,160	5.20	10,020
1.90	1,080	3.00	3,395	4.10	6,460	5.40	10,720
2.00	1,250	3.10	3,645	4.20	6,760	5.60	11,430
2.10	1,425	3.20	3,905	4.30	7,070	5.80	12,160
2.20	1,610	3.30	4,170	4.40	7,380	6.00	12,910

NOTE.—The above table is applicable only for open channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 1.2 feet and 4 feet. The table has been extended beyond these limits. Above 6 feet the discharge is estimated, being based on three high-water measurements of 1904.

Estimated monthly discharge of Wabash River at Logansport, Ind., for 1905.

[Drainage area, 3,163 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	13,370	2,118	5,561	1.76	2.03
April	14,670	1,014	4,774	1.51	1.68
May	33,750	1,518	6,961	2.20	2.54
June	9,680	890	3,318	1.05	1.17
July	3,829	402	1,065	.337	.388
August	2,675	345	1,154	.365	.421
September	7,444	438	1,946	.615	.686
October	2,118	420	865	.273	.315
November	13,290	570	1,769	.559	.624
December	8,180	1,080	3,398	1.07	1.23

NOTE.—No estimate for frozen period.

WABASH RIVER AT TERRE HAUTE, IND.

This station was established February 25, 1905. It is located at the Vandalia Line railway bridge near the city waterworks. There are no tributaries nor any islands, falls, or dams in the river near the station.

The channel is practically straight for 700 feet above and below the station. There is a considerable angle of approach on the right bank, but practically none at the left bank. The right bank is comparatively low and alluvial, but is protected by a levee that does not overflow. The left bank is high, covered with buildings, and does not overflow. All of the water passes between the abutments of the bridge. The bed of the stream is composed of hard, permanent material, is clean of vegetation, and always consists of but one channel. The current has a medium-swift velocity at low stages.

Discharge measurements are made from the downstream lower chord of the bridge. The initial point for soundings is the center of the truss pin through the left end of the downstream lower chord of the left span of the bridge.

A standard chain gage is fastened to the downstream side of the bridge, on the first span from the left bank; length of chain, 42.97 feet. During 1905 the gage was read by Albert Shewmaker. The gage is referred to bench marks as follows: (1) The Terre Haute city bench mark at the northeast corner of First and Chestnut streets; elevation 0.33 foot. (2) The southeast corner of the left abutment of the Vandalia Line railway bridge; elevation, 36.40 feet. (3) The base of the railroad rail immediately opposite the pulley at the gage box; elevation, 42.51 feet. Elevations refer to the datum of the gage. This is 0.33 foot below the city datum, which is 438.72 feet above mean sea level.

Information in regard to a former gaging station maintained in the city of Terre Haute is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 98, p 220.
Discharge: Ann 21, iv, p 171.
Gage heights: WS 83, p 177; 98, p 220.

Discharge measurements of Wabash River at Terre Haute, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 12	M. S. Brennan	557	5,584	2.82	6.90	15,750
June 25	do	521	3,839	1.91	3.74	7,367
July 29	do	480	2,652	1.00	1.42	2,648
August 25	do	502	2,963	1.25	2.00	3,700
September 11	do	495	2,773	1.19	1.81	3,311
October 15	do	455	2,525	.82	1.00	2,066

Daily gage height, in feet, of Wabash River at Terre Haute, Ind., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	13.7	5.1	8.6	6.4	2.2	1.72	1.5	1.42	1.9	9.55
2	.....	14.3	7.0	8.0	6.2	2.02	1.58	1.75	1.4	1.82	9.65
3	.....	14.4	7.2	6.7	6.6	2.88	1.38	1.75	1.3	1.85	8.62
4	.....	14.7	6.2	5.8	5.2	3.8	1.28	1.6	1.22	1.8	7.05
5	.....	15.0	5.2	5.3	4.6	2.78	1.22	1.85	1.18	1.88	6.02
6	.....	13.3	4.4	4.9	4.05	2.48	1.15	1.95	1.18	2.85	5.88
7	.....	10.6	3.9	4.7	4.7	2.28	1.3	1.88	1.18	3.4	5.3
8	.....	9.0	3.6	4.5	6.0	1.98	1.22	1.7	1.32	3.9	4.88
9	.....	8.2	3.3	4.9	5.6	2.35	1.48	1.5	1.3	3.98	4.4
10	.....	7.3	3.1	5.6	4.9	2.58	1.82	1.4	1.28	3.88	4.05
11	.....	6.6	3.0	5.3	4.6	4.0	1.68	1.92	1.18	3.62	3.8
12	.....	6.5	3.05	6.8	4.7	4.75	1.45	3.0	1.1	3.32	3.62
13	.....	6.2	3.1	12.7	5.2	4.25	1.28	3.1	1.02	3.05	3.42
14	.....	5.6	2.95	14.1	5.4	4.4	1.52	2.72	1.0	3.75	3.18
15	.....	5.0	2.72	15.1	5.1	4.4	2.62	2.4	1.0	2.52	2.85
16	.....	4.6	2.55	16.3	5.0	3.85	2.8	3.32	.95	2.38	2.65
17	.....	4.3	2.4	17.0	4.6	3.4	2.62	3.95	.9	2.22	2.48
18	.....	4.0	2.32	16.8	4.2	3.0	2.55	4.6	2.0	2.12	2.52
19	.....	4.35	2.15	15.7	4.8	2.68	2.25	5.0	3.4	2.02	2.55
20	.....	5.1	2.02	12.8	5.4	2.75	2.1	5.1	4.15	1.92	2.48
21	.....	5.6	2.82	9.5	7.3	4.6	2.38	4.8	4.92	1.82	2.62
22	.....	5.6	5.9	7.8	4.8	3.4	2.58	4.2	4.68	1.75	3.2
23	.....	5.5	9.2	6.6	4.1	2.65	[a]2.15	3.6	4.12	1.65	4.9
24	.....	5.8	10.9	5.7	3.9	2.28	1.72	3.2	3.68	1.65	7.08
25	.....	4.8	10.6	5.0	3.7	1.98	1.68	2.72	3.3	1.6	7.4
26	9.7	4.8	9.4	4.6	3.3	1.78	1.78	2.32	2.95	1.65	6.7
27	12.3	5.0	8.4	4.3	2.9	1.6	2.1	2.05	2.7	1.58	6.0
28	11.3	5.0	7.5	4.1	2.65	1.5	2.38	1.8	2.45	1.42	5.3
29	.....	4.5	8.0	3.9	2.5	1.42	2.3	1.68	2.2	2.1	4.9
30	.....	4.1	8.2	6.7	2.4	1.78	2.02	1.5	2.12	8.0	4.5
31	.....	4.5	.....	7.1	.....	1.68	1.75	.....	1.95	.....	4.48

[a] Gage height interpolated.

Station rating table for Wabash River at Terre Haute, Ind., from February 25 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	1,945	2.50	4,670	4.20	8,430	7.40	17,200
1.00	2,065	2.60	4,870	4.40	8,910	7.60	17,800
1.10	2,195	2.70	5,080	4.60	9,390	7.80	18,400
1.20	2,335	2.80	5,290	4.80	9,890	8.00	19,000
1.30	2,485	2.90	5,505	5.00	10,400	8.20	19,600
1.40	2,643	3.00	5,720	5.20	10,920	8.40	20,300
1.50	2,808	3.10	5,940	5.40	11,450	8.60	21,000
1.60	2,978	3.20	6,160	5.60	11,990	8.80	21,700
1.70	3,152	3.30	6,380	5.80	12,540	9.00	22,400
1.80	3,330	3.40	6,605	6.00	13,100	9.50	24,150
1.90	3,513	3.50	6,830	6.20	13,660	10.00	25,900
2.00	3,700	3.60	7,055	6.40	14,240	10.50	27,800
2.10	3,890	3.70	7,280	6.60	14,820	11.00	29,800
2.20	4,080	3.80	7,510	6.80	15,400	11.50	31,800
2.30	4,275	3.90	7,740	7.00	16,000	12.00	33,800
2.40	4,470	4.00	7,970	7.20	16,600		

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 1 foot and 4 feet. The table has been extended beyond these limits, being based on one measurement at 6.9 feet and also on well-defined area and mean-velocity curves to 12 feet. Above this point the curve is more uncertain as the river overflows.

Estimated monthly discharge of Wabash River at Terre Haute, Ind., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
March	48,800	7,970	18,690
April	29,400	3,738	11,750
May	60,800	7,740	22,560
June	16,900	4,470	9,787
July	9,765	2,676	5,454
August	5,290	2,265	3,495
September	10,660	2,643	5,164
October	10,190	1,945	4,077
November	19,000	2,676	5,033
December	25,380	4,630	10,650

TIPPECANOE RIVER NEAR DELPHI, IND.

This station was established March 14, 1903. It is located at the highway bridge at Springboro, Ind. The nearest railroad station is Delphi, 5 miles east of Springboro. The drainage area of Tippecanoe River at this station is 1,890 square miles.

The channel is straight for about 1,600 feet above and about 2,000 feet below the station. Its width at ordinary stages is 350 feet, broken by two piers, and at high water is 510 feet, broken by three piers. Both banks are high and can not overflow to any considerable extent. The bed of the stream is rocky and rough. The current is swift.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the face of the east abutment.

A standard chain gage is located on the second span from the east bank, one panel length beyond the center of the span; length of the chain, 25.66 feet. The gage was read during 1905 by Lois Imler. The bench mark is the head of an anchor bolt in the east abutment: it is the outside anchor of the downstream truss; elevation above the zero of the gage, 22.25 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 222-223; 128, p 86.
Discharge: 98, p 223; 128, p 87.
Discharge, monthly: 98, p 224; 128, p 88.
Gage heights: 98, p 223; 128, p 87.
Rating table: 98, p 224; 128, p 88.

Discharge measurements of Tippecanoe River near Delphi, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	S. K. Clapp	319	713	3.9	4.25	2,782
May 27	M. S. Brennan	325	682	3.23	4.29	2,203
June 13	S. K. Clapp	285	672	3.66	4.30	2,459
July 14	do	272	617	3.44	4.10	2,120
August 24	M. S. Brennan	256	294	1.89	2.98	556
October 5	do	251	276	1.76	2.98	486

Daily gage height, in feet, of Tippecanoe River near Delphi, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.04	.....	7.8	4.1	7.9	4.4	3.4	3.35	3.9	3.02	3.25	4.4
2	3.08	.....	6.9	4.0	7.8	4.2	3.35	3.3	3.5	3.09	3.25	4.4
3	3.09	.....	6.1	3.95	7.8	4.0	3.3	3.3	3.6	3.08	3.2	4.25
4	3.08	3.06	5.9	3.7	7.6	3.95	3.25	3.25	3.75	3.04	3.2	4.2
5	3.06	.....	5.7	3.65	7.4	3.9	3.15	3.15	3.7	3.02	3.15	4.0
6	3.03	.....	5.6	3.6	7.3	3.85	3.15	3.06	3.55	3.0	3.8	3 85
7	3.0	.....	5.5	3.5	7.2	3.75	3.25	3.0	3.45	2.98	4.1	3.8
8	3.0	.....	5.4	3.55	6.8	3.75	3.25	3.0	3.35	2.98	4.0	3.7
9	.....	.....	5.1	3.55	6.8	3.9	3.2	2.98	3.15	2.97	3.95	3.65
10	.....	.....	4.7	3.55	6.5	4.0	3.3	2.98	3.1	2.96	3.95	3.55
11	.....	3.1	4.1	3.5	5.6	4.5	3.7	2.97	3.09	2.96	3.9	3.5
12	.....	.....	4.1	3.5	10.1	4.3	4.3	2.99	3.06	2.95	3.9	3.45
13	.....	.....	4.05	3.7	9.4	4.4	4.1	3.0	3.1	2.94	3.8	3.45
14	3.0	.....	4.05	3.9	10.2	4.4	4.0	3.09	3.3	2.93	3.7	3.65
15	.....	.....	4.2	3.85	10.0	4.4	3.9	3.2	3.25	2.91	3.6	3.6
16	.....	.....	4.2	3.85	9.8	4.3	3.7	3.45	3.15	2.9	3.5	3.5
17	.....	.....	4.2	3.8	8.9	5.0	3.6	3.3	3.15	2.9	3.35	3.45
18	.....	3.12	4.2	3.75	7.6	5.6	3.45	3.15	3.15	3.15	3.35	3.4
19	.....	.....	4.1	5.2	6.5	5.0	3.45	3.15	3.1	4.4	3.3	3.4
20	.....	3.1	4.1	7.0	4.8	4.3	3.35	3.45	3.1	4.4	3.3	3.25
21	3.03	.....	4.05	6.1	4.8	4.2	3.25	3.4	3.09	4.3	3.3	2.3
22	.....	.....	4.1	6.0	4.7	4.3	3.2	3.35	3.08	4.1	3,3	3.4
23	.....	.....	4.3	6.0	4.7	4.05	3.2	3.3	3.1	4.0	3.25	4.8
24	.....	.....	4.3	6.50	4.6	3.85	3.15	3.25	3.1	3.95	3.25	4.65
25	.....	3.15	4.2	5.8	4.6	3.7	3.1	3.25	3.09	3.85	3.2	4.2
26	.....	.....	4.2	5.5	4.4	3.6	3.07	3.2	3.08	3.8	3.15	3.9
27	.....	.....	4.2	5.4	4.4	3.65	3.05	3.15	3.06	3.6	3.1	3.9
28	3.1	.....	4.1	7.8	4.4	3.7	3.02	3.08	3.05	3.35	3.1	3.85
29	.....	.....	4.1	8.0	4.5	3.5	3.35	3.01	3.04	3.3	4.3	3.35
30	.....	.....	4.2	7.9	4.5	3.45	3.65	2.95	3.03	3.3	4.4	3.8
31	.....	4.90	4.1	.....	4.7	.....	3.4	2.98	.....	3.25	.....	3.75

NOTE.—There were ice conditions during January and February. From January 9 to February 11 the river was frozen over except for a narrow channel near the west bank. February 12-28, river frozen entirely across. Gage heights are to surface of water in hole in ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 14	3.0	2.9	0.3
January 21	3.03	3.03	.35
January 28	3.1	3.12	.5
February 4	3.06	.....	.5
February 11	3.1	3.12	1.0
February 18	3.12	3.12	1.0
February 25	3.15	3.19	1.0

Station rating table for Tippecanoe River near Delphi, Ind., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	280	4.20	2,410	5.70	5,280	8.40	11,290
2.80	390	4.30	2,580	5.80	5,490	8.60	11,750
2.90	510	4.40	2,750	5.90	5,700	8.80	12,210
3.00	630	4.50	2,920	6.00	5,910	9.00	12,670
3.10	760	4.60	3,090	6.20	6,350	9.20	13,130
3.20	890	4.70	3,270	6.40	6,790	9.40	13,590
3.30	1,030	4.80	3,450	6.60	7,230	9.60	14,050
3.40	1,170	4.90	3,640	6.80	7,670	9.80	14,510
3.50	1,320	5.00	3,830	7.00	8,110	10.00	14,970
3.60	1,470	5.10	4,030	7.20	8,550	10.50	16,120
3.70	1,620	5.20	4,230	7.40	8,990	11.00	17,270
3.80	1,770	5.30	4,440	7.60	9,450	11.50	18,420
3.90	1,930	5.40	4,650	7.80	9,910	12.00	19,570
4.00	2,090	5.50	4,860	8.00	10,370	12.50	20,720
4.10	2,250	5.60	5,070	8.20	10,830	13.00	21,870

NOTE.—The above table is applicable only for open-channel conditions. It is based on 23 discharge measurements made during 1903–1905. It is not very well defined.

Estimated monthly discharge of Tippecanoe River near Delphi, Ind., for 1905.

[Drainage area, 1,890 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	9,910	2,170	3,411	1.80	2.08
April	10,370	1,320	3,708	1.96	2.19
May	15,430	2,750	7,507	3.97	4.58
June	5,070	1,245	2,331	1.23	1.37
July	2,580	656	1,197	.633	.730
August	1,245	570	847	.448	.516
September	1,930	669	960	.508	.567
October	2,750	510	1,121	.593	.684
November	2,750	760	1,383	.732	.817
December	3,450	1,030	1,799	.962	1.10

NOTE.—No estimate for frozen period.

WEST BRANCH OF WHITE RIVER AT INDIANAPOLIS, IND.

This station was established May 6, 1904. It is located in the central portion of the city, on the bridge of the Cleveland, Cincinnati, Chicago and St. Louis Railway.

The channel is straight for about 500 feet above and 1,000 feet below the station. The right bank is high and seldom overflows. The left bank is high, covered with buildings, and never overflows. All the water passes between the abutments of the bridge. The bed of the stream is composed of gravel and sand, and is fairly permanent. There is one channel at all stages. At low water the current is too sluggish to permit of very accurate measurements.

Discharge measurements are made from the downstream side of the bridge of three spans, to which the gage is attached. The initial point for soundings is the downstream inner face of the right abutment.

A standard chain gage is attached to the downstream side of the bridge, its length from the end of the weight to the marker, which is the outside of the ring, being 37.10 feet. The gage was read during 1905 by J. D. Burk. The chain and weight are kept at the water-softening plant of the Kingan Packing Company, 100 feet downstream from the right abutment of the bridge. The gage is referred to bench marks as follows: (1) The south capstone of the ballast wall of the right abutment; elevation, 36.51 feet. (2) The downstream top edge of the fifth cross girder from the right abutment of the bridge; elevation, 36.54 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 128, p 89.
Discharge: 98, p 227; 128, p 89.
Discharge, monthly: 128, p 91.
Gage heights: 128, p 90.
Rating table: 128, p 90.

Discharge measurements of West Branch of White River at Indianapolis, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 15	S. K. Clapp	250	1,415	1.00	8.80	1,408
May 13	M. S. Brennan	328	2,836	3.04	13.30	8,626
June 14	S. K. Clapp	243	1,277	.57	8.05	730
September 11	M. S. Brennan	272	1,452	.98	8.98	1,427
October 18	do	239	1,234	.50	7.94	621

Daily gage height, in feet, of West Branch of White River at Indianapolis, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.5	7.3	11.8	10.6	10.4	11.0	7.6	7.3	7.8	7.7	7.75	8.3
2	8.3	7.2	12.1	9.8	9.4	9.8	7.6	7.3	7.7	8.35	7.7	8.4
3	8.15	7.1	11.2	9.3	9.0	9.3	7.65	7.35	7.6	10.3	7.7	8.8
4	7.65	7.1	10.8	8.9	8.75	8.8	7.65	7.3	7.7	10.7	7.65	9.9
5	7.85	7.15	10.1	8.75	8.6	8.5	7.6	7.3	7.8	9.6	7.9	8.2
6	7.85	7.15	9.6	8.5	8.65	8.7	7.6	7.3	7.75	9.0	8.4	8.4
7	7.8	7.1	9.4	8.4	9.0	8.8	7.6	7.75	7.65	8.6	9.7	8.6
8	7.55	7.1	9.6	8.2	9.2	8.9	7.6	7.65	7.6	8.3	9.35	8.3
9	7.4	7.2	10.2	8.15	8.95	8.5	7.8	7.6	7.5	8.2	8.9	8.15
10	7.35	7.15	10.7	8.1	8.7	8.3	8.0	7.6	7.6	8.15	8.5	8.1
11	7.5	7.15	9.8	10.3	8.9	8.2	7.85	7.5	7.85	8.0	8.3	8.0
12	8.1	7.15	9.5	10.2	13.2	8.2	7.8	7.5	11.1	7.95	8.15	7.95
13	8.8	7.1	9.1	10.0	13.3	8.2	8.2	7.65	11.5	8.0	8.1	7.9
14	8.9	6.95	8.9	9.3	12.5	7.95	8.2	7.85	9.8	7.9	8.0	7.85
15	8.7	7.0	8.75	8.85	11.1	8.0	8.0	8.2	9.0	7.85	7.95	7.7
16	8.25	7.0	8.9	8.6	10.4	7.9	7.85	8.65	9.1	7.8	7.85	7.65
17	8.2	7.1	8.6	8.4	10.0	7.95	7.7	8.8	11.7	7.7	7.8	7.65
18	8.2	7.1	8.75	8.3	9.8	7.9	7.7	8.6	12.0	7.9	7.8	7.6
19	8.1	7.2	8.8	8.2	9.5	7.9	7.6	8.5	10.8	8.25	7.75	7.6
20	8.0	7.2	8.9	8.3	9.2	7.95	7.55	8.3	9.6	9.15	7.7	7.65
21	7.95	7.25	8.95	10.1	9.0	8.2	7.55	8.3	9.3	9.1	7.6	7.75
22	7.9	7.35	8.8	11.9	8.7	8.4	7.5	8.9	8.8	8.85	7.6	9.9
23	7.75	7.55	8.65	11.8	8.5	8.3	7.55	8.5	8.5	8.6	7.55	10.5
24	7.7	8.0	8.6	10.4	8.35	8.1	7.55	8.2	8.3	8.3	7.5	10.1
25	7.3	9.7	9.1	9.6	8.2	8.0	7.5	8.6	8.2	8.15	7.5	9.5
26	7.2	10.9	9.1	9.3	8.15	7.9	7.5	9.9	8.0	8.0	7.5	8.95
27	7.4	11.7	8.8	9.2	8.1	7.65	7.45	9.6	7.9	8.0	7.5	8.6
28	7.5	11.4	8.55	9.2	8.0	7.6	7.35	8.9	7.85	7.9	7.65	8.4
29	7.35	.....	8.5	9.4	8.3	7.6	7.3	8.5	7.85	7.8	7.7	8.35
30	7.3	.....	9.5	10.4	12.4	7.6	7.3	8.15	7.75	7.75	7.9	8.5
31	7.35	.....	11.0	.....	12.2	.....	7.3	7.9	.....	7.8	.....	8.6

NOTE.—Ice conditions unknown; discharge applied as for open channel.

Station rating table for West Branch of White River at Indianapolis, Ind., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.90	125	8.20	800	9.50	2,005	11.40	4,655
7.00	150	8.30	880	9.60	2,115	11.60	5,005
7.10	180	8.40	960	9.70	2,225	11.80	5,375
7.20	215	8.50	1,045	9.80	2,345	12.00	5,765
7.30	255	8.60	1,130	9.90	2,465	12.20	6,165
7.40	300	8.70	1,215	10.00	2,585	12.40	6,585
7.50	350	8.80	1,305	10.20	2,845	12.60	7,015
7.60	400	8.90	1,395	10.40	3,125	12.80	7,455
7.70	455	9.00	1,490	10.60	3,405	13.00	7,905
7.80	515	9.10	1,585	10.80	3,695	13.50	9,055
7.90	580	9.20	1,685	11.00	3,995	14.00	10,210
8.00	650	9.30	1,785	11.20	4,315		
8.10	725	9.40	1,895				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1904 5. It is well defined between gage heights 7.2 feet and 9 feet. The table has been extended beyond these limits, being based on one measurement at 13.3 feet.

Estimated monthly discharge of West Branch of White River at Indianapolis, Ind., for 1905.

[Drainage area, 1,520 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,395	215	598	0.393	0.453
February	5,185	138	759	.499	.520
March	5,965	1,045	2,171	1.43	1.65
April	5,565	725	1,992	1.31	1.46
May	8,595	650	2,522	1.66	1.91
June	3,995	400	971	.639	.713
July	800	255	436	.287	.331
August	2,465	255	803	.528	.609
September	5,765	350	1,491	.981	1.09
October	3,545	455	1,008	.663	.764
November	2,225	350	669	.440	.491
December	3,265	400	1,076	.708	.816
The year	8,595	138	1,208	.786	10.81

See gage height footnote.

EEL RIVER AT CATARACT, IND.

This station was established August 6, 1903. It is located 6 miles from Cloverdale, Ind., and one-half mile northeast of Cataract, Ind. It is 300 feet above a dam, below which there is a fall of 35 feet. The drainage area of Eel River at this station is 255 square miles.

The channel is straight for about 500 feet above and 300 feet below the bridge. Both banks are high and rocky and will not overflow. The bed of the stream is a smooth rock ledge, nearly level between the bridge abutments. The current varies from swift to rather sluggish.

Discharge measurements are made from the upstream side of the single-span covered highway bridge, which has a length between abutments of 128 feet. The initial point for soundings is the face of the left abutment at the top of the coping on the upstream side of the bridge.

The gage is a 3 by 6 inch oak timber, securely fastened to the west abutment on the downstream face. The gage was read during 1905 by Joseph Steiner. Bench marks were established as follows: (1) A wire nail in the root of a small elm tree in a stone wall on the north side of the road approaching the bridge on the west side of the river and about 50 feet from the bridge; elevation, 12.60 feet. (2) A wire nail in the root of a large oak tree in the pasture on the west side of the river, 300 feet from the bridge and 20 feet from the fence which bounds the south side of the road approaching the bridge; elevation, 27.20 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 218-219; 128, pp 91 92.
Discharge: 98, p 219.
Gage heights: 98, p 219; 128, p 92.

Daily gage height, in feet, of Eel River at Cataract, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	2.1	3.3	2.4	3.9	2.0	2.0	1.1	1.6	1.6	1.8	2.4
2	3.2	2.1	3.4	2.3	3.8	2.0	1.9	1.1	1.5	1.4	1.8	2.5
3	3.1	2.1	3.5	2.2	3.8	2.0	1.8	1.0	1.6	1.3	1.9	2.4
4	3.0	2.0	3.6	2.1	3.7	2.0	1.7	1.0	1.8	1.2	1.9	2.3
5	2.9	2.0	3.6	2.1	3.5	2.1	1.6	1.0	1.9	1.2	2.0	2.2
6	2.8	1.6	3.5	2.0	3.4	2.1	1.7	1.0	1.9	1.1	2.0	2.2
7	2.7	1.6	3.4	2.0	3.3	2.0	1.8	1.1	1.8	1.1	2.1	2.3
8	2.8	1.6	3.2	2.0	3.2	2.0	2.0	1.1	1.8	1.2	2.0	2.3
9	2.8	1.6	3.0	1.9	3.5	2.1	2.0	1.2	1.8	1.2	2.0	2.4
10	2.9	1.6	2.9	1.8	3.6	2.0	2.0	1.2	1.7	1.3	1.9	2.4
11	2.9	1.6	2.8	1.8	3.6	2.1	1.9	1.3	1.7	1.3	1.9	2.4
12	3.0	1.6	2.8	1.7	3.5	2.1	1.9	1.2	1.6	1.4	2.0	2.3
13	3.0	1.6	2.7	1.6	3.5	2.0	1.8	1.3	1.5	1.5	2.0	2.3
14	3.0	1.6	2.7	1.6	3.4	2.1	1.9	1.4	1.4	1.6	2.1	2.2
15	2.9	1.7	2.7	1.6	3.2	2.2	2.0	1.6	1.3	1.6	2.1	2.1
16	2.9	1.8	2.6	1.6	3.1	2.3	2.0	1.7	1.2	1.7	2.0	2.0
17	2.8	1.8	2.5	1.6	3.0	2.4	1.9	1.9	1.2	1.8	1.9	2.0
18	2.8	1.8	2.5	1.7	2.9	2.5	1.8	2.0	1.1	1.9	1.9	2.1
19	2.7	2.0	2.4	1.7	2.8	2.6	1.7	2.5	1.1	2.0	1.8	2.2
20	2.6	2.2	2.4	1.9	2.7	2.7	1.6	2.4	1.0	2.1	1.7	2.3
21	2.6	2.3	2.3	1.9	2.6	2.8	1.5	2.4	1.0	2.3	1.6	2.4
22	2.6	2.5	2.2	2.0	2.6	2.9	1.4	2.3	1.0	2.3	1.5	2.4
23	2.6	2.8	2.2	2.0	2.5	2.8	1.3	2.2	1.0	2.3	1.5	2.3
24	2.6	3.0	2.1	2.0	2.4	2.7	1.2	2.1	1.1	2.2	1.4	2.4
25	2.6	3.0	2.0	2.2	2.3	2.6	1.2	2.0	1.2	2.1	1.5	2.5
26	2.6	3.0	2.0	2.3	2.3	2.5	1.3	2.0	1.4	2.1	1.6	2.6
27	2.6	3.1	2.0	2.5	2.2	2.4	1.3	2.0	1.5	2.0	1.7	2.6
28	2.6	3.2	2.1	2.7	2.2	2.3	1.4	1.9	1.6	2.0	1.9	2.7
29	2.5	.....	2.2	4.0	2.1	2.2	1.4	1.9	1.6	2.0	2.0	2.8
30	2.4	.....	2.3	4.0	2.1	2.1	1.3	1.8	1.7	1.9	2.0	2.8
31	2.3	.....	2.3	.....	2.1	.....	1.2	1.7	.....	1.8	.....	2.7

NOTE.—Ice conditions unknown.

EAST BRANCH OF WHITE RIVER AT SHOALS, IND.

This station was established June 25, 1903. It is located at the highway bridge in the village of Shoals, Ind., 400 feet above the Baltimore and Ohio Southwestern Railroad bridge. There are rapids just below this station, also about 5½ miles below.

The channel is straight above and below the station. The right bank is a high, rocky road embankment and never overflows; the left bank is a steep, rocky bluff and does not overflow. The bed of the stream is rocky, and the channel is divided into three parts by the bridge piers. The current is swift.

Discharge measurements are made from the three-span highway bridge, to which the gage is attached. The initial point for soundings is the face of the left abutment.

A standard chain gage is fastened to the railing and metal posts of the downstream side of the first span on the left end of the highway bridge; length of the chain, 46.41 feet. The gage was read during 1905 by O. H. Griest. The bench mark is the stone cap on the downstream end of the first pier from the left bank. Its elevation is 100.00 feet above the gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 216-217; 128, p 93.
Discharge: 98, p 217; 128, p 93.
Discharge, monthly: 98, p 218; 128, p 95.
Gage heights: 98, p 217; 128, p 94.
Rating table: 98, p 218; 128, p 95.

Discharge measurements of East Branch of White River at Shoals, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 16	S. K. Clapp	355	1,421	4.28	66.00	6,090
May 15	M. S. Brennan	406	4,248	4.26	73.58	18,120
June 15	S. K. Clapp	330	744	2.47	64.40	1,838
October 16	M. S. Brennan	313	564	1.74	63.80	982

Daily gage height, in feet, of East Branch of White River at Shoals, Ind., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	65.5	63.9	66.4	66.0	67.0	66.4	64.3	63.8	65.1	63.9	65.6	66.3
2	65.0	64.0	68.4	66.0	67.2	66.8	64.2	63.8	65.6	64.0	65.4	69.0
3	64.7	63.8	67.9	65.9	67.5	66.4	64.1	63.8	65.0	64.0	65.3	70.0
4	64.5	63.8	68.0	65.6	67.0	65.8	64.1	63.7	64.7	64.1	65.2	71.0
5	64.3	63.7	68.1	65.3	65.8	65.4	64.0	63.6	64.3	64.1	66.0	70.8
6	64.3	63.7	67.1	65.0	66.1	65.2	64.0	63.6	64.2	64.3	66.5	69.3
7	64.1	63.7	66.7	64.9	67.0	65.9	64.0	63.5	64.2	64.5	66.5	68.4
8	63.9	63.7	67.1	64.8	67.3	64.9	64.0	63.6	64.0	64.6	66.8	67.0
9	63.7	63.7	70.6	64.7	67.5	64.9	63.9	63.7	64.0	64.6	67.0	66.5
10	63.6	63.8	71.5	64.5	68.0	65.0	63.9	63.7	64.0	64.4	66.7	65.6
11	63.6	63.9	71.7	65.1	68.8	64.9	64.0	63.8	64.2	64.2	66.2	65.4
12	65.5	64.0	70.0	65.3	69.6	64.8	64.2	64.0	64.2	64.1	65.8	65.2
13	65.5	64.2	68.9	65.4	71.6	64.6	64.3	64.1	64.1	64.0	65.5	65.2
14	66.4	64.4	67.2	65.4	72.8	64.5	64.3	64.8	64.1	63.9	65.2	65.1
15	66.0	64.5	66.4	65.2	74.0	64.4	64.2	66.2	64.2	63.8	65.2	65.0
16	65.7	64.6	66.0	65.0	75.2	64.3	64.2	65.7	64.2	63.8	65.0	64.9
17	66.8	64.4	65.8	64.8	76.2	64.3	64.2	66.1	64.2	64.0	64.9	64.8
18	67.2	64.2	65.5	64.6	75.3	64.5	64.1	66.1	64.1	65.3	64.8	64.7
19	65.8	64.0	65.4	64.5	72.3	64.3	64.0	66.0	64.0	69.1	64.8	64.8
20	65.2	63.9	65.2	64.4	69.7	64.8	64.0	66.7	64.0	71.1	64.8	65.0
21	64.7	64.2	65.2	64.6	67.4	65.0	63.9	66.1	64.2	69.4	64.9	65.8
22	64.5	65.0	65.1	66.6	66.4	65.4	63.9	65.9	64.3	69.8	65.0	67.0
23	64.4	65.2	65.0	67.7	66.0	65.6	64.0	65.8	64.3	68.7	64.9	68.2
24	63.8	66.0	65.0	68.7	65.6	65.8	64.4	66.0	64.1	67.3	64.8	68.4
25	63.8	67.1	65.0	67.5	65.4	65.4	64.4	66.0	64.0	67.0	64.7	68.5
26	63.8	70.3	65.0	67.0	65.2	65.1	64.3	65.9	63.9	68.0	64.7	67.9
27	63.9	71.6	65.0	66.9	65.1	64.9	64.3	65.7	63.8	67.9	64.7	66.9
28	64.0	68.2	65.7	66.4	65.0	64.7	64.2	65.4	63.8	68.0	64.9	66.5
29	64.0	.....	65.2	66.2	64.9	64.6	64.0	65.3	63.8	67.3	65.1	66.0
30	64.0	.....	65.6	66.4	65.0	64.4	63.9	65.2	63.8	66.6	65.8	65.9
31	63.9	.....	66.0	.....	65.0	.....	63.8	64.9	.....	66.0	.....	65.8

Station rating table for East Branch of White River at Shoals, Ind., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
63.50	570	65.40	4,041	67.30	8,390	70.40	15,520
63.60	670	65.50	4,266	67.40	8,620	70.60	15,980
63.70	790	65.60	4,492	67.50	8,850	70.80	16,440
63.80	918	65.70	4,718	67.60	9,080	71.00	16,900
63.90	1,050	65.80	4,945	67.70	9,310	71.20	17,360
64.00	1,190	65.90	5,172	67.80	9,540	71.40	17,820
64.10	1,338	66.00	5,400	67.90	9,770	71.60	18,280
64.20	1,500	66.10	5,630	68.00	10,000	71.80	18,740
64.30	1,673	66.20	5,860	68.20	10,460	72.00	19,200
64.40	1,856	66.30	6,090	68.40	10,920	72.50	20,350
64.50	2,051	66.40	6,320	68.60	11,380	73.00	21,500
64.60	2,259	66.50	6,550	68.80	11,840	73.50	22,700
64.70	2,479	66.60	6,780	69.00	12,300	74.00	23,900
64.80	2,700	66.70	7,010	69.20	12,760	74.50	25,100
64.90	2,922	66.80	7,240	69.40	13,220	75.00	26,300
65.00	3,145	66.90	7,470	69.60	13,680	75.50	27,500
65.10	3,365	67.00	7,700	69.80	14,140	76.00	28,700
65.20	3,592	67.10	7,930	70.00	14,600	76.50	29,900
65.30	3,816	67.20	8,160	70.20	15,060		

NOTE.—The above table is applicable only for open channel conditions. It is based on 14 discharge measurements made during 1903-1905. It is fairly well defined between gage heights 63.2 feet and 69 feet. The table has been extended beyond these limits, being based on one measurement at 95.2 feet. This measurement may be considerably in error owing to backwater.

Estimated monthly discharge of East Branch of White River at Shoals, Ind., for 1905.

[Drainage area, 4,900 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	8,160	670	2,694	0.550	0.634
February	18,280	790	3,216	.656	.683
March	18,510	3,145	7,320	1.50	1.73
April	11,610	1,856	4,801	.980	1.09
May	29,180	2,922	10,698	2.18	2.51
June	7,240	1,673	3,363	.686	.765
July	1,856	918	1,315	.268	.309
August	7,010	570	3,191	.651	.750
September	4,492	918	1,591	.325	.363
October	17,130	918	5,264	1.07	1.23
November	7,700	2,479	4,106	.838	.935
December	16,900	2,479	7,263	1.48	1.71
The year	29,180	570	4,568	.932	12.71

NOTE.—Practically no ice conditions; discharge applied as for open channel.

TENNESSEE RIVER BASIN.

DESCRIPTION OF BASIN.

Tennessee River is formed by the junction of the French Broad and the Holston, about 4 miles above Knoxville, Tenn. It flows southwestward, crossing into Alabama about 40 miles below Chattanooga, Tenn., and, after crossing the northern part of Alabama, again enters Tennessee in Harding County. It then flows northward, crossing Tennessee and Kentucky, and enters Ohio River at Paducah, about 40 miles above Cairo. Its principal tributary on the north is Clinch River, which enters it near Kingston, Roan County, Tenn. The principal tributaries on the south are Hiwassee and Little Tennessee rivers. The Hiwassee rises in the northern part of Georgia and flows into the Tennessee about 30 miles above Chattanooga. Its principal tributaries are the Ocoee and Nottely. Little Tennessee River rises in the northeast corner of Georgia, flows across the southwestern part of North Carolina, and enters the Tennessee near Loudon, Tenn. Its principal tributary is the Tuckasegee. French Broad River rises in the western part of North Carolina. Its principal tributaries are the Pigeon and the Nolichucky. Holston River rises in the western part of Virginia. Its principal tributary is Watauga River.

FRENCH BROAD RIVER AT HORSESHOE, N. C.

This station was established October 4, 1904, by B. S. Drane. It is located at the steel highway bridge at Horseshoe, N. C.

The channel is straight for about 2,000 feet above and 1,500 feet below the station. The current is of fair velocity at all stages except the lowest, when it becomes sluggish along the right bank. The right bank is of earth, wooded, and about 15 feet high. The left bank is similar, but is cleared. The earth embankments which form the bridge approaches on either side are of such a height that all the water passes beneath the bridge and through a flood channel 81 feet wide, which is opened through the embankment 140 feet from the left end of the bridge.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is on the downstream hand rail over the inner edge of the capstone of the left abutment.

A plain staff gage, graduated to feet and tenths, is attached vertically to a 1½ by 4 inch oak timber, which is driven into the bed of the stream to a firm foundation and nailed to an overhanging birch on the right bank, 25 feet below the bridge. It is read once each day by Charles Duncan. The gage is referred to bench marks as follows: (1) The upper surface of the downstream end of the first floor beam from the left bank, 15 feet from the initial point for soundings; elevation, 20.48 feet. (2) The center of the head of a wire nail driven into the downstream face of a large birch tree on the right bank, about 20 feet above the bridge; elevation, 12.40 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey, No. 128, pages 98-99.

Discharge measurements of French Broad River at Horseshoe, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	B. S. Drane	81	439	2.02	3.10	888
June 22	do	81	522	2.22	3.84	1,159
August 29	do	81	488	2.27	3.60	1,109
November 11	W. E. Hall	81	259	1.60	1.37	415

Daily gage height, in feet, of French Broad River at Horseshoe, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.7	4.0	2.4	2.6	3.3	6.8	3.1	3.2	1.8	1.65	1.3
2	1.45	1.65	3.9	2.35	2.4	3.0	7.2	2.8	4.0	1.8	1.6	1.3
3	1.45	1.6	3.8	2.3	2.4	2.8	4.8	2.8	3.8	1.85	1.55	9.4
4	1.4	1.5	3.5	2.25	4.0	2.7	3.7	2.9	3.4	2.4	1.5	6.3
5	1.15	1.5	3.4	2.4	4.7	2.7	3.4	3.2	3.2	2.0	1.5	3.5
6	1.25	1.9	3.3	3.2	8.4	2.6	3.8	2.9	2.95	1.8	1.45	2.7
7	4.7	1.8	3.3	2.7	6.3	2.4	3.8	2.85	2.8	1.75	1.45	2.3
8	2.7	2.35	3.3	2.4	5.7	2.35	4.8	2.8	2.75	1.65	1.45	3.6
9	2.0	3.4	3.2	2.4	4.8	2.2	3.7	6.5	2.7	1.6	1.4	9.0
10	.95	5.0	5.2	2.8	4.6	2.1	3.2	5.5	2.65	1.6	1.4	9.3
11	.65	3.8	4.8	2.5	4.0	2.1	6.6	10.2	2.55	6.9	1.4	5.4
12	8.4	3.1	4.0	2.6	3.6	2.0	12.5	10.8	2.55	4.4	1.4	4.4
13	10.2	6.3	4.2	3.8	3.3	2.0	13.8	10.5	2.5	2.7	1.4	3.6
14	7.0	5.3	3.8	3.4	3.2	1.85	15.2	7.5	2.4	2.3	1.35	3.2
15	4.5	4.0	3.5	2.9	2.9	2.4	15.0	6.3	2.4	2.1	1.35	3.6
16	3.7	3.0	3.3	3.0	5.9	10.2	7.8	5.4	2.35	2.0	1.3	4.6
17	3.2	3.0	3.1	2.7	4.8	8.9	6.7	5.3	2.3	2.0	1.25	3.8
18	2.7	2.85	3.0	2.5	3.8	6.3	6.0	4.5	2.25	1.9	1.2	3.4
19	2.55	2.6	2.9	2.35	3.4	4.2	5.7	4.4	2.35	1.85	1.2	3.1
20	2.5	2.8	2.8	2.3	3.2	4.4	5.3	4.4	2.3	1.8	1.45	3.2
21	2.35	8.9	3.3	2.25	3.0	4.9	5.0	4.3	2.3	1.8	1.7	7.3
22	2.2	6.7	3.7	2.2	3.3	3.9	5.3	4.6	2.15	1.8	1.45	5.3
23	2.1	6.7	3.2	2.15	3.2	3.8	4.6	5.6	2.0	1.75	1.35	4.6
24	2.0	6.0	3.0	2.1	4.0	3.3	4.2	6.6	2.0	1.7	1.3	4.7
25	1.8	5.4	3.1	2.1	3.3	2.75	4.0	6.0	1.95	1.65	1.3	4.4
26	2.5	5.0	2.9	2.9	3.5	2.7	3.2	5.4	1.9	1.85	1.3	3.8
27	3.4	4.6	2.75	2.6	5.8	2.75	3.4	4.5	1.85	1.95	1.3	3.5
28	3.6	4.4	2.5	2.4	6.3	2.7	4.1	4.0	1.85	1.8	1.25	3.2
29	2.4	.....	2.5	2.3	4.5	2.4	3.8	3.6	1.8	1.75	1.25	5.1
30	2.2	.....	2.5	3.2	4.2	3.2	3.4	3.4	1.8	1.7	1.3	4.4
31	1.8	.....	2.6	.....	3.6	.....	3.4	3.3	.....	1.7	.....	4.5

FRENCH BROAD RIVER AT SMITH BRIDGE, NEAR ASHEVILLE, N. C.

This station is located at the steel highway bridge known as Smith Bridge, about 1 mile below the Southern Railway depot at Asheville, N. C., and near the end of the Patton avenue line of the Asheville Street Railway Company. The United States Weather Bureau maintains a station at this place, and during 1904 a number of discharge measurements were made by the United States Geological Survey. During 1905 the discharge measurements have been continued and the gage heights have been furnished by the Weather Bureau.

The channel is straight for about 1,500 feet above and 800 feet below the station. There is but one channel at all stages, broken by three piers at ordinary and four at high-water stages. The banks are not high, but all water will probably be confined between the abutments, as the road has been raised by embankments. The current is fairly swift and somewhat irregular. The bed is of sand and bowlders and is irregular.

Discharge measurements are made from the walkway on the upstream side of the bridge, the initial point for soundings being the end of the hand rail at the left bank. The bridge has five spans of 100 feet each, supported by four stone piers and two stone abutments.

A new boxed chain gage has been installed by the Weather Bureau to take the place of the vertical gage which is attached to the southwest corner of the second stone pier from the left bank. It is located on the downstream side of the bridge in the second panel to the left of the pier to which the vertical gage is attached. The length of the chain is 26.45 feet. The bench mark is the top of the downstream end of the second floor beam to the left of the second pier from the left bank; elevation, 20.08 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Bull.=Bulletin; Ann.=Annual Report; WS=Water-Supply Paper):

Description: Bull 140, pp 80-81; WS 15, p 60; 27, p 59; 36, pp 165-166; 48, p 186; 65, p 301; Ann 18, iv, p 116; 128, pp 99-100, 100-101.

Discharge: Ann 18, iv, p 116; Bull 140, p 80; WS 15, p 60; 27, p 65; 36, p 166; 48, p 186; 65, p 301; 128, pp 100-101.

Discharge, monthly: Ann 19, iv, p 257-258; 20, iv, p 205; 21, iv, p 160; 22, iv, p 223; WS 75, p 103.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: Bull 140, p 81; WS 11, p 42; 15, p 60; 27, p 62; 36, p 166; 48, p 186; 65, p 301.

Hydrographs: Ann 19, iv, pp 258-259; 20, iv, p 205; 21, iv, p 161.

Rating tables: Ann 19, iv, p 257; WS 27, p 66; 39, p 446; 52, p 515; 65, p 323.

Discharge measurements of French Broad River at Smith Bridge, near Asheville, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	B. S. Drane	318	930	1.70	−0.07	1,577
June 28	do	320	964	1.74	0.00	1,674
August 26	do	331	1,339	2.48	1.18	3,326
November 10	W. E. Hall	300	679	1.37	− .52	931

Daily gage height, in feet, of French Broad River at Smith Bridge, near Asheville, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	−0.5	−0.4	0.5	−0.3	−0.1	0.4	0.5	0.1	0.1	−0.5	−0.5	−0.6
2	− .5	− .4	.5	− .3	− .2	.2	2.0	.1	.4	− .5	− .5	−0.6
3	− .6	− .6	.4	− .3	− .3	.1	1.5	.1	.8	− .5	− .5	2.8
4	− .8	−.6	.2	− .4	.2	.0	.5	.1	.5	− .2	− .5	2.3
5	− .8	− .6	.2	− .3	.7	.0	.4	.3	.1	− .3	− .5	.6
6	− .6	− .6	.1	.3	1.7	.2	.8	.2	.0	− .4	− .5	.2
7	1.9	.0	.1	.1	1.2	− .3	.6	.0	.0	− .5	− .5	− .2
8	.0	.1	.1	− .1	1.3	− .4	.6	.0	− .2	− .5	− .6	1.9
9	− .5	− .1	− .1	− .1	.8	− .4	.5	1.5	− .1	− .5	− .6	2.8
10	− .5	.9	.5	.1	1.0	− .4	1.1	2.3	− .1	− .6	− .6	2.8
11	− .6	.5	1.0	.0	.8	− .4	2.4	3.3	− .2	.0	− .6	1.5
12	.0	.1	.5	.4	.4	− .4	5.7	3.9	− .2	1.3	− .6	.8
13	3.4	1.0	.6	.6	.4	− .4	6.0	3.5	− .2	.0	− .6	.7
14	2.9	1.6	.6	.4	.2	− .4	5.1	2.7	− .2	− .3	− .6	.5
15	.9	1.0	.3	.2	.2	− .4	4.4	1.7	− .2	− .4	− .6	.4
16	.4	.5	.2	.2	1.8	.5	3.0	1.7	− .2	− .4	− .6	.8
17	.0	.1	.1	.1	1.5	3.0	3.0	1.1	− .3	− .4	− .6	.5
18	.0	.2	.1	.0	.8	2.5	1.6	.9	− .3	− .4	− .6	.4
19	− .2	− .5	.0	− .1	.4	3.0	1.5	.7	− .3	− .4	− .6	.2
20	− .2	− .4	.0	− .2	.2	1.3	1.2	.7	− .3	− .5	− .6	.1
21	− .3	2.5	.1	− .2	.2	1.0	1.0	.6	− .3	− .5	− .6	2.0
22	− .3	2.0	.5	− .2	.2	.8	1.1	.5	− .3	− .5	− .5	1.8
23	− .3	2.1	.1	− .3	.5	.7	.9	1.0	− .3	− .5	− .6	1.2
24	− .3	− .3	1.6	.0	.6	.4	.7	1.4	− .4	− .5	− .6	1.0
25	− .3	1.1	.3	− .4	.3	.2	1.0	1.6	− .4	− .5	− .6	.8
26	− .3	1.0	.1	− .3	.3	.1	.5	1.4	− .4	− .5	− .6	.5
27	− .2	.8	.0	− .1	.3	.3	.3	.9	− .5	− .5	− .6	.3
28	.0	.5	− .1	− .2	3.0	.1	.5	.5	− .5	− .4	− .6	.2
29	− .2	.....	− .2	− .2	1.5	− .1	1.0	1.0	− .5	− .4	− .6	.8
30	− .2	.....	− .1	.1	.9	.1	.8	.8	− .5	− .5	− .6	.7
31	− .1	.....	− .2	.....	.6	.....	.2	.2	.....	− .5	.....	.5

Station rating table for French Broad River at Smith Bridge, near Asheville, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−1.00	420	0.40	2,190	1.70	4,150	3.00	6,310
−0.90	510	0.50	2,330	1.80	4,310	3.20	6,670
−0.80	610	0.60	2,470	1.90	4,470	3.40	7,030
−0.70	720	0.70	2,620	2.00	4,630	3.60	7,390
−0.60	840	0.80	2,770	2.10	4,790	3.80	7,750
−0.50	960	0.90	2,920	2.20	4,950	4.00	8,110
−0.40	1,090	1.00	3,070	2.30	5,120	4.20	8,490
−0.30	1,220	1.10	3,220	2.40	5,290	4.40	8,870
−0.20	1,350	1.20	3,370	2.50	5,460	4.60	9,250
−0.10	1,490	1.30	3,520	2.60	5,630	4.80	9,630
0.00	1,630	1.40	3,670	2.70	5,800	5.00	10,010
0.10	1,770	1.50	3,830	2.80	5,970	5.50	11,010
0.20	1,910	1.60	3,990	2.90	6,140	6.00	12,010
0.30	2,050						

NOTE.—The above table is based on nine discharge measurements made during 1904-5. It is well defined between gage heights −0.9 foot and 1.2 feet. The table has been extended beyond these limits.

Estimated monthly discharge of French Broad River at Smith Bridge, near Asheville, for 1905.

[Drainage area, 987 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	7,030	610	1,743	1.77	2.04
February	5,460	840	2,255	2.28	2.37
March	3,990	1,350	1,996	2.02	2.33
April	2,470	1,090	1,536	1.56	1.74
May	6,310	1,220	2,637	2.67	3.08
June	6,310	1,090	2,211	2.24	2.50
July	12,010	1,910	4,178	4.23	4.88
August	7,930	1,630	3,320	3.36	3.87
September	2,770	960	1,406	1.42	1.58
October	3,520	840	1,145	1.16	1.34
November	960	840	872	.883	.985
December	5,970	840	2,961	3.00	3.46
The year	12,010	840	2,188	2.22	30.18

FRENCH BROAD RIVER AT OLDTOWN, TENN.

This was originally one of the temporary stations established in connection with the general hydrographic study of the southern Appalachian region.

The channel is straight for about 600 feet above and below the station. The velocity is moderately swift, and is considerably obstructed by old piling and logs. Both banks are high and wooded, and all water passes beneath the bridge at all stages. The bed is of gravel and sand.

Discharge measurements are made from the downstream side of the steel highway bridge of four spans. The initial point for soundings is the end of the guard rail at the left end of the bridge, on the downstream side.

The original gage put in at this station was carried away with the old bridge by flood early in the spring of 1902. A wire gage was established on the new bridge October 27, 1902, by B. S. Drane. The wire gage was replaced April 29, 1903, by a standard chain gage at the same datum. The length of the chain is 28.00 feet. The gage is referred to bench marks as follows: (1) A point marked in white paint on the sharp rectangular corner of the angle-iron connection between the floor beam and the first post on the downstream side in the second span from the left end of the bridge; elevation, 25.84 feet. (2) The top of a copper bolt set in a bowlder projecting from the hillside on the left bank 175 feet downstream from the center line of the bridge, 8 feet from the center of the road, and about 4 feet above ground. This rock is the first smooth-faced ledge of limestone outcropping close to the road. The face next the road is nearly vertical for a length of 4 feet. Elevation of bench mark, 29.52 feet. Elevations refer to the datum of the gage. The station was abandoned December 31, 1905.

Information in regard to this station is contained in the following water-supply papers of the United States Geological Survey:

Description: 48, p 187; 65, p 302; 83, p 223; 98, pp 279-280; 128, pp 101-102.
Discharge: 48, p 187; 65, p 302; 83, p 223; 98, p 280; 128, p 102.
Discharge, monthly: 98, p 282; 128, p 103.
Gage heights: 48, p 187; 65, p 302; 83, p 223; 98, pp 280-281; 128, p 102.
Rating tables: 65, p 323; 98, p 281; 128, p 103.

Discharge measurements of French Broad River at Oldtown, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 9	B. S. Drane	395	2,028	2.25	2.50	4,564
May 11	W. E. Hall	379	2,059	2.05	2.54	4,208
June 20	B. S. Drane	396	2,125	2.14	2.70	4,547
August 21	W. E. Hall	361	1,964	1.53	2.13	3,007
December 19	F. A. Murray	375	1,894	1.38	1.95	2,627
December 26	do	377	2,002	1.70	2.19	3,399

Daily gage height, in feet, of French Broad River at Oldtown, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.55	2.0	2.25	1.65	1.9	2.05	2.15	1.95	1.8	1.35	1.4	1.35
2	1.5	1.65	2.15	1.65	1.8	1.95	3.0	1.9	1.9	1.35	1.35	1.35
3	1.6	1.6	2.1	1.6	1.7	1.85	2.75	1.8	2.2	1.4	1.3	4.1
4	1.6	1.55	2.05	1.6	1.7	1.75	2.25	1.8	2.0	1.5	1.3	3.3
5	1.4	1.5	2.0	1.7	2.6	1.75	2.2	1.95	1.9	1.6	1.3	2.4
6	1.75	1.55	1.95	2.1	2.55	1.8	2.65	1.9	1.8	1.5	1.35	1.9
7	2.2	1.65	1.9	2.2	3.2	1.7	2.4	1.95	1.75	1.5	1.4	1.8
8	2.25	1.9	1.95	2.0	3.8	1.7	2.05	2.25	1.7	1.4	1.35	1.7
9	1.8	2.5	2.0	1.95	2.9	1.7	2.1	3.0	1.65	1.35	1.3	2.7
10	1.8	2.9	2.25	2.25	2.45	1.6	2.4	2.75	1.65	1.4	1.3	3.8
11	1.7	2.55	2.65	2.1	2.5	1.6	2.5	3.6	1.65	1.5	1.35	3.0
12	2.4	2.2	2.4	2.85	2.2	1.65	9.3	4.6	1.6	2.55	1.3	2.35
13	4.8	2.5	2.3	2.6	2.75	1.9	7.6	4.2	1.6	1.95	1.25	2.1
14	4.1	3.0	2.2	2.4	2.55	1.65	6.0	3.7	1.6	1.65	1.3	1.95
15	2.65	2.5	2.1	2.2	2.4	1.55	5.1	3.1	1.55	1.5	1.3	1.9
16	2.15	2.1	2.0	2.0	4.0	1.6	4.1	2.7	1.55	1.5	1.3	2.25
17	2.0	2.05	1.95	1.95	3.8	3.6	3.1	2.6	1.55	1.5	1.25	2.1
18	1.95	2.0	1.85	1.9	2.85	3.4	2.8	2.4	1.5	1.45	1.25	2.0
19	1.9	1.9	1.8	1.8	2.4	3.2	2.4	2.3	1.5	1.4	1.3	1.9
20	1.8	2.1	1.85	1.75	2.2	2.75	2.8	2.4	1.6	1.55	1.25	1.9
21	1.7	4.4	1.9	1.75	2.05	2.5	2.55	2.1	1.6	1.5	1.3	2.3
22	1.7	4.3	2.1	1.75	2.15	2.5	2.7	2.1	1.6	1.5	1.35	2.9
23	1.65	3.8	1.95	1.7	2.7	2.35	2.65	2.2	1.5	1.4	1.3	2.6
24	1.6	3.2	1.9	1.6	2.5	2.2	2.4	2.3	1.5	1.4	1.3	2.6
25	1.6	2.85	1.85	1.6	2.35	2.0	2.3	2.6	1.45	1.4	1.3	2.35
26	1.5	2.65	1.85	1.65	2.15	1.9	2.2	2.45	1.4	1.5	1.25	2.15
27	1.4	2.5	1.8	1.75	2.25	2.4	2.1	2.3	1.4	1.55	1.25	2.0
28	1.3	2.4	1.75	1.8	3.1	2.1	2.2	2.1	1.35	1.55	1.3	1.95
29	1.2	.....	1.7	1.85	3.0	1.9	2.4	2.0	1.4	1.5	1.35	2.0
30	1.15	.....	1.7	1.95	2.4	1.95	2.7	1.9	1.35	1.45	1.4	2.2
31	1.5	.....	1.7	.....	2.25	.....	2.2	1.9	.....	1.4	.....	2.0

Station rating table for French Broad River at Oldtown, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	400	1.90	2,410	2.80	5,140	3.70	8,805
1.00	535	2.00	2,680	2.90	5,500	3.80	9,245
1.10	685	2.10	2,955	3.00	5,875	3.90	9,690
1.20	850	2.20	3,235	3.10	6,260	4.00	10,140
1.30	1,030	2.30	3,525	3.20	6,660	4.20	11,050
1.40	1,225	2.40	3,825	3.30	7,075	4.40	11,980
1.50	1,435	2.50	4,135	3.40	7,500	4.60	12,920
1.60	1,660	2.60	4,455	3.50	7,930	4.80	13,860
1.70	1,900	2.70	4,790	3.60	8,365	5.00	14,800
1.80	2,150						

NOTE.—The above table is based on 13 discharge measurements made during 1904-5 and 1 measurement made in 1903 to determine the upper part of the curve. It is well defined between gage heights 1 foot and 3 feet.

Estimated monthly discharge of French Broad River at Oldtown, Tenn., for 1905.

[Drainage area, 1,737 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	13,860	768	2,703	1.56	1.80
February	11,980	1,435	4,188	2.41	2.51
March	4,622	1,900	2,688	1.55	1.79
April	5,320	1,660	2,508	1.44	1.61
May	10,140	2,025	4,493	2.59	2.99
June	8,365	1,548	3,051	1.76	1.96
July	36,300	2,818	6,942	4.00	4.61
August	12,920	2,150	4,319	2.49	2.87
September	3,235	1,128	1,730	.996	1.11
October	4,295	1,128	1,502	.865	.997
November	1,225	940	1,051	.605	.675
December	10,590	1,128	3,679	2.12	2.44
The year	36,300	768	3,238	1.86	25.36

SWANNANOA RIVER AT BILTMORE, N. C.

This station was established May 21, 1904, for the purpose of making miscellaneous measurements. It is located at the Biltmore, N. C., terminal of the Asheville-Biltmore electric railway line, about three-fourths of a mile above the mouth of Swannanoa River.

The channel is straight for about 1,000 feet above and curved for 300 feet below the station. The current is sluggish above and somewhat swifter below the bridge. Both banks are high and not subject to overflow. The bed of the stream is composed of sand. There is but one channel at all stages.

Discharge measurements are made from the upstream side of a single-span highway bridge. The initial point for soundings is the right end of the upstream hand rail of the bridge.

Bench marks were established as follows: (1) The center of the center-pin bearing at the upstream end of the second floor beam from the right bank; elevation, 16.00 feet. (2) The center of the head of a small wire nail driven into a triangular-shaped blaze in the downstream side of a birch tree on the right bank, about 25 feet above the bridge; elevation, 5.74 feet. Elevations refer to the datum of the assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, page 104.

Discharge measurements of Swannanoa River at Biltmore, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	B. S. Drane	74	140	1.19	1.24	167
June 28	do	75	140	1.24	1.22	175
August 26	do	75	158	1.28	1.29	204

TENNESSEE RIVER NEAR KNOXVILLE, TENN.

This station was originally established by the United States Weather Bureau at the Gay street or county highway bridge, which has been torn down and replaced by a new bridge.

The channel is straight for one-half mile above and 1,000 feet below the station. The right bank will overflow for about 400 feet and the left bank for 200 feet, beyond which points steep high bluffs begin on both sides of the river. The bed is of rocks and gravel, and is rough and probably permanent. The current is swift and somewhat broken by the rough bed and by the remains of old piers.

Until recently discharge measurements have been made from the Cherokee Bridge, about 2½ miles downstream from the Gay Street Bridge, at which measurements are now made, and which is one-half mile above the Knoxville and Augusta Railroad bridge. The Gay Street Bridge has 7 spans, with a total length of 1,570 feet. The floor of the bridge is about 100 feet above low water. The initial point for soundings is the end of the bridge on the right bank, downstream side.

When the old bridge was removed it was decided to move the gage down the river in order to get below some shoals and wing dams which have been put in for boating. A temporary gage was put in at the Knoxville and Augusta Railroad bridge, half a mile below the Gay Street Bridge, and was used during the greater part of the year 1899. In the latter part of that year a new permanent gage was established, and readings from it began November 1, 1899. The new gage is on the right bank of the river, just below the mouth of West Knoxville Bayou and about 1,000 feet below the temporary gage at the Knoxville and Augusta Railroad bridge. The gage is in two sections—the first, a sloping section made of a 2 by 4 inch pine timber spiked on top of an 8 by 8 inch oak sill well bolted to piles and imbedded in crushed stone, reading from −2 to +12 feet; the second, a vertical section, attached to one of the bents of the railroad trestle across West Knoxville Bayou, about 50 feet from the bank of the river, reading from 12 to 36.5 feet. The gage is fastened to the upstream post of the bent, facing away from the river. The gage was located for the United States Weather Bureau by the United States Engineer Corps. Daily records are kept by the United States Weather Bureau and are furnished to the Geological Survey. The zero of the gage is 804.3 feet above sea level. The bench mark is a cross in the stone on the east corner of the base of right-bank pier of the Knoxville and Augusta Railroad bridge. Elevation, 2.40 feet above the zero of the gage and 806.7 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 36, pp 172-173; 48, pp 193-194; 65, p 303; 83, pp 220-221; 98, p 276; 128, pp 104-105.
Discharge: 36, p 173; 48, p 194; 65, p 303; 83, p 221; 98, p 277; 128, p 105.
Discharge, monthly: 75, pp 103-104; 83, p 222; 98, p 279; 128, p 107.
Gage heights: 36, p 173; 48, p 194; 65, p 304; 83, p 221; 98, p 277; 128, p 106.
Rating tables: 65, p 324; 83, p 222; 98, p 278; 128, p 106.

Discharge measurements of Tennessee River near Knoxville, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 15	B. S. Drane	894	8,013	3.50	7.00	28,040
April 14	O. P. Hall	883	6,178	3.49	5.32	21,580
May 10	W. E. Hall	856	6,383	3.39	5.26	21,630
August 26	do	876	5,255	3.03	3.33	15,920
October 11	O. P. Hall	630	2,977	1.51	.72	4,484
December 27	F. A. Murray	856	5,126	2.52	3.09	12,900

Daily gage height, in feet, of Tennessee River near Knoxville, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	1.3	4.3	2.0	3.0	2.4	2.1	4.0	1.6	0.4	0.6	0.4
2	1.5	1.4	4.0	2.0	2.8	2.2	1.8	2.4	1.5	.4	.5	.4
3	1.8	1.2	3.6	1.8	2.4	2.1	2.3	2.1	2.4	.5	.5	1.9
4	2.3	1.1	3.4	1.7	2.1	1.9	2.2	1.8	2.3	.5	.4	6.8
5	2.2	1.1	3.4	1.7	1.9	1.7	1.8	1.6	1.9	.5	.4	6.8
6	2.2	2.1	3.2	2.2	2.4	1.6	1.8	1.6	1.8	.6	.4	4.4
7	2.2	2.3	3.1	3.7	3.0	1.5	2.5	1.6	2.2	.6	.4	2.7
8	3.7	2.8	3.2	4.5	4.7	1.4	2.5	1.9	1.6	.6	.4	2.0
9	3.3	8.5	4.7	4.2	6.2	1.3	2.1	3.1	1.4	.5	.5	2.5
10	2.5	10.8	9.7	4.4	5.4	1.2	1.9	4.3	1.2	.4	.4	4.5
11	2.0	8.7	9.2	4.7	4.0	1.2	2.1	4.0	1.1	.7	.4	5.4
12	3.7	6.6	8.6	4.3	3.6	1.1	2.7	6.3	1.1	1.0	.4	4.1
13	8.5	5.5	6.4	5.4	3.9	1.4	12.0	8.0	1.1	1.7	.3	3.0
14	10.8	6.6	5.2	5.4	4.9	1.6	11.7	7.5	1.2	1.5	.3	2.4
15	8.4	7.4	4.5	4.5	6.6	1.3	9.3	6.0	1.2	1.1	.3	2.0
16	5.1	5.1	3.9	3.8	8.1	1.3	6.7	5.0	1.0	.8	.3	2.0
17	3.7	4.6	3.5	3.3	10.1	1.2	5.0	4.7	.9	.7	.3	2.2
18	3.0	3.9	3.2	3.0	9.1	3.7	3.8	4.2	.9	.6	.3	2.2
19	2.6	3.6	2.9	2.6	6.7	3.7	3.3	4.0	.8	.5	.3	2.0
20	2.5	3.8	2.8	2.3	5.0	3.3	4.3	3.1	.8	.6	.4	1.8
21	2.4	10.1	2.8	2.2	4.0	3.0	3.6	2.8	.8	.7	.4	1.8
22	2.1	11.0	2.9	2.4	3.6	2.9	3.0	2.4	.8	.7	.4	2.0
23	2.0	10.0	2.9	2.2	3.9	2.8	3.1	2.3	.9	.6	.5	4.0
24	1.8	8.5	2.8	2.1	4.4	2.6	3.7	2.7	.8	.5	.5	5.1
25	1.6	7.3	2.5	2.1	3.9	2.4	4.0	3.5	.7	.5	.4	4.6
26	1.2	6.0	2.4	1.9	3.3	2.1	3.2	3.2	.6	.7	.4	4.0
27	.7	5.2	2.4	2.5	2.8	2.7	2.6	3.2	.6	.7	.3	3.2
28	.5	4.7	2.3	2.2	2.9	3.3	2.2	2.8	.5	.9	.3	2.8
29	.6	.....	2.2	2.3	3.0	2.4	2.1	2.3	.5	1.0	.3	2.5
30	1.0	.....	2.1	3.4	3.4	1.9	2.4	1.9	.4	.9	.4	2.3
31	1.3	.....	2.1	.....	2.8	.....	2.8	1.7	.....	.7	.....	2.4

Station rating table for Tennessee River near Knoxville, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−0.40	1,750	1.30	6,150	3.00	12,190	6.40	26,100
−0.30	1,930	1.40	6,480	3.20	12,950	6.60	26,990
−0.20	2,120	1.50	6,820	3.40	13,710	6.80	27,890
−0.10	2,320	1.60	7,160	3.60	14,480	7.00	28,790
0.00	2,530	1.70	7,500	3.80	15,260	7.20	29,710
0.10	2,750	1.80	7,850	4.00	16,040	7.40	30,630
0.20	2,980	1.90	8,200	4.20	16,840	7.60	31,560
0.30	3,220	2.00	8,550	4.40	17,640	7.80	32,500
0.40	3,470	2.10	8,900	4.60	18,450	8.00	33,440
0.50	3,730	2.20	9,260	4.80	19,270	8.50	35,840
0.60	4,000	2.30	9,620	5.00	20,090	9.00	38,290
0.70	4,280	2.40	9,980	5.20	20,930	9.50	40,790
0.80	4,570	2.50	10,340	5.40	21,770	10.00	43,340
0.90	4,870	2.60	10,710	5.60	22,620	10.50	45,940
1.00	5,180	2.70	11,080	5.80	23,480	11.00	48,590
1.10	5,500	2.80	11,450	6.00	24,340	11.50	51,290
1.20	5,820	2.90	11,820	6.20	25,220	12.00	54,040

The above table is based on discharge measurements made during 1900-1905 and is well defined.

Estimated monthly discharge of Tennessee River near Knoxville, Tenn., for 1905.

[Drainage area, 8,990 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	47,530	3,730	12,280	1.37	1.58
February	48,590	5,500	22,740	2.53	2.64
March	41,810	8,900	15,950	1.77	2.04
April	21,770	7,500	12,430	1.38	1.54
May	43,860	8,200	17,710	1.97	2.27
June	14,870	5,500	9,002	1.00	1.12
July	54,040	7,850	15,550	1.73	1.99
August	33,440	7,160	14,050	1.56	1.80
September	9,980	3,470	5,745	.637	.713
October	7,500	3,470	4,354	.484	.558
November	4,000	3,220	3,448	.384	.428
December	27,890	3,470	12,600	1.40	1.61
The year	54,040	3,220	12,150	1.35	18.29

TENNESSEE RIVER AT CHATTANOOGA, TENN.

This station was established in 1879, at the foot of Lookout street, just below Chattanooga Island, by the Signal Corps of the United States Army; but since July 1, 1891, it has been in charge of the Weather Bureau.

The channel is curved for 3,000 feet above and 2,000 feet below the station. The right bank is high and overflows at flood stages, but all water passes under the bridge or its approach. The left bank is a high, rocky bluff and will not overflow. The bed is composed of loose rock, sand, and gravel and is fairly constant.

Discharge measurements are made from the steel highway bridge of six spans and an approach about 1,000 feet long on the right bank. The floor of the bridge is about 125 feet above low water. The initial point for soundings is the outside corner of the iron post of the downstream hand rail on the left bank.

The gage consists of a sloping section made of railroad rails bolted to solid rock and a vertical section of heavy timber bolted to the vertical face of the rock cliff. During the year 1900 a new gage was established. It is a vertical metal scale bolted to the south side of the third stone pier from the south end of the Hamilton County highway bridge. The original sloping gage, however, is still considered standard, as the later gage is not properly adjusted at its lower end on account of the projecting base of the pier. The self-registering gage invented by Professor Fulton, of Tennessee University, is also in use at this station. The gage is connected by wire with the Weather Bureau office, and a continuous electrical record of river height is made in the same manner as the record of wind, sunshine, etc. Gage heights are furnished to the Geological Survey through L. M. Pindell. The bench mark is the top of the water table on the southeast corner of the post-office on Eleventh street. Its elevation is 74.40 feet above the zero of the gage and 705 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 119; WS 15, p 64; 27, p 60; 36, p 174; 48, p 195; 65, p 311; 83, p 203; 98, pp 255-256; 128, pp 107-108.

Discharge: Ann 18, iv, p 119; WS 15, p 64; 27, p 65; 36, p 174; 48, p 195; 65, p 311; 83, p 203; 98, p 256; 128, p 108.

Discharge, monthly: Ann 18, iv, pp 120-122; 19, iv, p 261; 20, iv, p 210; 21, iv, p 168; 22, iv, p 228; WS 75, p 109; 83, p 205; 98, p 257.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, pp 43-46; 15, p 64; 27, p 64; 36, p 175; 48, p 195; 65, p 312; 83, p 203; 98, p 256; 128, p 108.

Hydrographs: Ann 19, iv, p 262; 20, iv, p 211; 21, iv, p 168; 22, iv, p 228; WS 75, p 109.

Rating tables: Ann 18, iv, p 120; 19, iv, p 260; WS 39, p 446; 27, p 66; 52, p 515; 65, p 324; 83, p 204; 98, p 257.

Discharge measurements of Tennessee River at Chattanooga, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 9	W. E. Hall	1,097	11,190	3.58	6.65	40,020
June 13	B. S. Drane	1,055	7,188	2.26	2.92	16,250
June 29	do	1,072	10,760	3.32	6.28	35,680
July 22	Hall and Hoyt	1,081	9,418	3.10	5.32	29,160
October 11	F. A. Murray	1,007	5,801	1.77	1.65	10,270
December 28	do	1,104	12,150	3.57	7.44	43,380

Daily gage height, in feet, of Tennessee River at Chattanooga, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	2.8	8.6	4.8	8.6	5.9	8.6	3.8	3.4	1.3	2.6	1.3
2	5.4	3.2	7.9	4.8	8.0	5.4	6.3	3.8	3.3	1.3	2.4	1.6
3	5.4	3.2	7.3	4.5	6.9	4.8	5.2	4.3	3.5	1.4	2.2	2.4
4	4.0	3.1	6.8	4.4	6.2	4.3	4.4	3.9	3.3	1.4	2.0	[illegible]
5	4.2	3.0	6.4	4.3	5.7	4.1	4.2	3.3	3.5	1.6	1.9	[illegible]
6	4.5	3.8	6.1	4.4	5.3	3.8	4.1	3.0	3.5	1.7	1.8	9.7
7	4.3	5.1	5.9	4.5	5.1	3.7	3.9	3.0	3.3	1.7	1.7	8.8
8	4.6	6.4	5.6	5.0	5.5	3.5	4.0	2.8	3.3	1.6	1.6	7.1
9	4.8	12.1	5.9	4.9	6.5	3.4	4.5	3.2	3.2	1.5	1.6	6.6
10	5.2	20.4	10.6	6.2	7.9	3.4	4.6	3.5	3.0	1.5	1.6	9.5
11	5.0	22.4	16.2	6.3	8.0	3.1	4.5	5.1	2.7	1.6	1.6	9.7
12	5.1	20.2	17.3	6.7	7.2	3.0	5.2	6.5	2.5	2.6	1.5	9.4
13	9.6	16.0	15.4	7.0	6.3	2.9	6.6	7.2	2.8	3.2	1.5	8.1
14	17.2	13.6	13.4	7.3	5.8	3.0	10.5	8.4	2.7	3.7	1.4	6.9
15	16.4	13.3	10.6	7.8	5.8	3.1	12.7	8.9	2.5	3.0	1.4	6.[illegible]
16	15.1	12.2	8.8	7.4	7.2	3.2	11.3	8.8	2.4	3.0	1.3	6.7
17	11.3	11.2	7.7	6.7	10.9	3.3	9.2	7.6	2.4	2.6	1.3	6.5
18	8.1	9.4	6.9	6.0	13.7	3.3	7.3	7.0	2.3	2.3	1.3	6.0
19	6.6	8.3	6.4	5.5	13.5	3.1	6.2	6.4	2.2	2.1	1.2	5.7
20	5.8	7.9	6.0	5.1	11.8	4.3	5.5	6.1	2.0	1.9	1.3	4.5
21	5.3	14.9	6.5	4.7	9.6	4.9	5.1	5.8	2.0	1.8	1.3	6.3
22	5.0	21.4	7.0	4.7	7.8	5.0	5.4	5.1	1.9	1.8	1.4	7.[illegible]
23	4.7	21.0	7.5	4.7	7.4	6.0	5.1	4.6	1.8	1.9	1.6	[illegible]
24	4.4	19.4	7.0	4.7	9.5	5.9	4.7	4.2	1.7	2.0	1.6	9.4
25	4.0	15.6	6.4	4.5	10.2	5.7	4.8	5.8	1.7	1.9	1.5	11.0
26	3.7	13.1	6.1	4.4	8.8	5.1	5.0	7.0	1.6	2.1	1.5	10.4
27	3.4	11.2	5.7	5.3	7.6	4.5	5.4	6.0	1.6	2.9	1.5	9.0
28	2.9	9.7	5.4	6.2	6.8	4.4	4.8	5.4	1.5	3.3	1.5	7.8
29	2.4	.....	5.2	6.4	6.1	6.0	4.2	5.0	1.4	3.3	1.5	7.0
30	2.4	.....	5.1	7.6	5.8	5.6	3.8	4.5	1.4	3.0	1.5	6.4
31	2.7	.....	4.9	.....	5.9	.....	3.8	4.0	.....	2.9	.....	6.0

Station rating table for Tennessee River at Chattanooga, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.00	4,800	1.10	8,210	2.20	12,790	3.60	19,520
.10	5,060	1.20	8,580	1.30	13,240	3.80	20,560
.20	5,330	1.30	8,960	2.40	13,700	4.00	21,620
.30	5,610	1.40	9,350	2.50	14,160	4.20	22,700
.40	5,900	1.50	9,750	2.70	14,620	4.40	23,820
.50	6,200	1.60	10,160	2.70	15,090	4.60	24,980
.60	6,510	1.70	10,590	2.80	15,560	4.80	26,180
.70	6,830	1.80	11,020	2.90	16,040	5.00	27,420
.80	7,160	1.90	11,460	3.00	16,520	5.20	28,680
.90	7,500	2.00	11,900	3.20	17,500	5.40	29,960
1.00	7,850	2.10	12,340	3.40	18,500	5.60	31,260

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 1.2 feet and 7.5 feet. The table has been extended beyond these limits. Above gage height 5.50 feet the rating curve is a tangent, the difference being 660 per tenth.

Estimated monthly discharge of Tennessee River at Chattanooga, Tenn., for 1904–5.

[Drainage area, 21,400 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
January	64,260	9,750	20,840	0.974	1.12
February	53,700	13,240	26,620	1.24	1.34
March	138,200	32,580	62,750	2.93	3.38
April	53,700	20,040	28,570	1.34	1.50
May	44,460	14,620	26,690	1.25	1.44
June	26,800	11,900	17,200	.804	.897
July	23,260	10,590	15,670	.732	.844
August	22,160	12,790	16,380	.765	.882
September	13,700	6,510	9,169	.428	.478
October	6,830	5,060	5,507	.257	.296
November	8,210	5,060	7,067	.330	.368
December	61,620	8,210	20,130	.941	1.08
The year	138,200	5,060	21,380	.999	13.62
1905.					
January	107,800	13,700	35,470	1.66	1.91
February	142,100	15,560	71,110	3.32	3.46
March	108,500	26,800	47,030	2.20	2.54
April	45,780	23,260	31,160	1.46	1.63
May	84,720	28,040	45,700	2.14	2.47
June	33,900	16,040	23,430	1.09	1.22
July	78,120	20,560	33,110	1.55	1.79
August	53,040	15,560	29,850	1.40	1.61
September	19,010	9,350	14,180	.663	.740
October	20,040	8,960	12,850	.600	.692
November	14,620	8,580	10,220	.478	.533
December	66,900	9,750	42,390	1.98	2.28
The year	142,100	8,580	33,040	1.54	20.88

DAVIDSONS RIVER NEAR DAVIDSONS RIVER, N. C.

This station was established May 19, 1904, by M. R. Hall. It is located at English Bridge, about 2 miles from Davidsons River, N. C., and about 500 feet above the mouth of Avery Creek.

The channel is straight for about 500 feet above and below the station. The current is moderately swift. The right bank is high, rocky, wooded, and is not subject to overflow. The left bank is low, but is not subject to overflow. The bed of the stream is composed of rock, mostly loose bowlders and shingle, and is clean and permanent. There is but one channel at all stages.

Discharge measurements are made from the single-span wooden highway bridge, with log abutments. The floor of the bridge is about 12 feet above low water. The initial point for soundings is the edge of the wooden crib abutment on the upstream side at the left bank. The gage is a vertical timber 10 feet long, spiked to the downstream side of a maple tree on the left bank, 40 feet below the bridge. The gage is read once each day by J. J. Perry. It is referred to bench marks as follows: (1) Two wire nails driven into the downstream side of the tree to which the gage is attached; elevation, 4.00 feet. (2) A cross cut on the top of solid rock at edge of water, 8 feet below the bridge, at right bank; elevation, 1.48 feet. (3) The center of a nail head in the third log from the bottom of crib at the right bank on

the upstream side; elevation, 7.00 feet. (4) The top of the head of a large nail driven horizontally into an 18-inch white-oak tree on the left bank, just upstream from the end of the bridge: the nail is in the quarter of the tree downstream and away from the river, and about 5 feet above the root of the tree; elevation, 14.12 feet. Elevations refer to datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 109–110.

Discharge measurements of Davidsons River near Davidsons River, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	B. S. Drane	71	128	1.03	1.25	132
April 13	do	71	128	1.04	1.24	133
June 23	do	67	116	.98	1.16	113
June 23	do	67	116	.99	1.16	115
August 30	do	66	111	.85	1.08	94
August 30	do	66	111	.88	1.08	98
November 14	W. E. Hall	64	90	.42	.75	38

Daily gage height, in feet, of Davidsons River near Davidsons River, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	0.9	1.2	1.05	1.05	1.15	1.7	1.05	1.05	0.8	0.8	0.75
2	.9	.9	1.2	1.05	1.05	1.1	1.3	1.05	1.1	.8	.8	.75
3	.95	.9	1.2	1.0	1.2	1.1	1.15	1.05	1.05	.8	.8	1.55
4	.9	1.1	1.2	1.0	1.2	1.05	1.1	1.05	1.05	.9	.8	1.1
5	.9	1.1	1.2	1.15	1.35	1.05	1.05	1.1	1.0	.85	.8	.95
6	1.25	1.15	1.15	1.1	1.5	1.0	1.25	1.05	1.0	.8	.8	.95
7	1.1	1.05	1.2	1.05	1.4	1.0	1.15	1.05	1.0	.8	.8	.9
8	1.0	1.05	1.15	1.0	1.3	1.0	1.25	1.35	1.0	.8	.8	1.2
9	.95	1.4	1.25	1.15	1.25	.95	1.15	1.2	.95	.8	.8	1.8
10	.95	1.35	1.55	1.05	1.2	.95	1.1	1.6	.95	.9	.8	1.35
11	.95	1.15	1.3	1.05	1.15	.95	2.6	2.15	.95	1.3	.8	1.2
12	2.6	1.3	1.3	1.4	1.15	.95	2.95	2.0	1.0	.9	.8	1.1
13	1.6	1.7	1.25	1.25	1.1	.9	2.05	1.75	.95	.85	.75	1.05
14	1.4	1.3	1.25	1.2	1.1	.9	1.9	1.6	.95	.85	.75	1.0
15	1.25	1.3	1.2	1.15	1.05	.9	1.7	1.5	.9	.85	.75	1.45
16	1.2	1.3	1.2	1.1	1.3	1.35	1.6	1.4	.9	.85	.75	1.15
17	1.15	1.15	1.15	1.1	1.15	1.15	1.5	1.35	.9	.8	.75	1.1
18	1.1	1.15	1.15	1.05	1.1	1.1	1.45	1.3	.9	.8	.75	1.05
19	1.05	1.05	1.1	1.05	1.1	1.3	1.45	1.3	.9	.8	.75	1.0
20	1.05	1.6	1.1	1.05	1.05	1.3	1.4	1.25	.9	.8	.85	1.15
21	1.0	1.55	1.3	1.0	1.1	1.2	1.35	1.25	.9	.8	.8	1.5
22	1.0	1.5	1.2	1.0	1.05	1.3	1.3	1.2	.9	.8	.75	1.3
23	1.0	1.45	1.15	1.0	1.15	1.15	1.25	1.2	.85	.8	.75	1.25
24	.95	1.35	1.15	1.0	1.15	1.1	1.25	1.2	.85	.8	.75	1.2
25	.95	1.3	1.1	1.0	1.2	1.05	1.2	1.2	.85	.82	.8	1.15
26	1.0	1.3	1.1	1.15	1.5	1.0	1.2	1.2	.85	.87	.75	1.1
27	1.0	1.25	1.1	1.05	1.45	1.0	1.15	1.15	.85	.85	.75	1.1
28	1.0	1.25	1.05	1.0	1.45	.95	1.2	1.1	.85	.8	.75	1.05
29	.95	.....	1.05	1.0	1.3	.98	1.15	1.1	.8	.8	.75	1.2
30	.95	.....	1.1	1.1	1.2	1.1	1.15	1.1	.8	.8	.75	1.1
31	.9	.....	1.05	.....	1.2	.....	1.1	1.05	.....	.8	.....	1.1

Station rating table for Davidsons River near Davidsons River, N. C., from June 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.60	24	1.30	146	1.90	311	2.50	512
.70	32	1.40	171	2.00	342	2.60	549
.80	44	1.50	197	2.10	374	2.70	587
.90	60	1.60	224	2.20	407	2.80	626
1.00	79	1.70	252	2.30	441	2.90	666
1.10	100	1.80	281	2.40	476	3.00	707
1.20	122						

NOTE.—The above table is based on 15 discharge measurements made during 1904–5. It is well defined between gage heights 0.7 foot and 1.3 feet. Beyond these limits the table is uncertain.

Estimated monthly discharge of Davidsons River near Davidsons River, N. C., for 1904–5.

[Drainage area, 41 square miles.]

Month.	Discharge in second-feet.			Run-off.		Rainfall in inches.[a]
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.	
1904.						
June	111	52	73.0	1.78	1.99	4.51
July	90	44	55.4	1.35	1.56	2.54
August	238	60	113	2.76	3.18	5.51
September	100	44	67.3	1.64	1.83	1.38
October	44	38	39.7	.968	1.12	.00
November	122	38	47.0	1.15	1.28	2.11
December	146	38	59.8	1.46	1.68	4. 4
1905.						
January	549	60	104	2.54	2.93	5.49
February	252	60	135	3.29	3.43	6.73
March	210	90	119	2.90	3.34	2.95
April	171	79	95.7	2.33	2.60	4.30
May	197	90	126	3.07	3.54	10.19
June	158	60	94.0	2.29	2.56	3.89
July	686	90	186	4.54	5.23	8.94
August	390	90	147	3.59	4.14	6.81
September	100	44	66.5	1.62	1.81	2.40
October	146	44	50.8	1.24	1.43	3.72
November	52	38	41.3	1.01	1.13	.16
December	281	38	114	2.78	3.20	9.71
The year	686	38	107.7	2.60	35.34	65.31

[a] At Brevard.

AVERY CREEK AT DAVIDSONS RIVER, N. C.

This station was established May 19, 1904, for the purpose of making miscellaneous measurements. It is located about one-fourth mile above the junction of Avery Creek with Davidsons River and a less distance from the regular gaging station on the latter stream.

The channel is curved for about 100 feet above and straight for 50 feet below the station when it curves to the right. The current is swift. The right bank is high, wooded, and not liable to overflow. The left bank is low, wooded, and overflows at high stages. The bed of the stream is rocky along the right bank and sandy for the remainder. It is not liable to change. There is but one channel at all stages.

The bench mark is a small shelf chipped in the upper edge of the upstream face of the large rock on the right bank upon which the end of the foot log rests; elevation, 5.00 feet above datum of assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 110-111.

Discharge measurements of Avery Creek at Davidsons River, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	B. S. Drane	18	16	1.39	1.91	[illegible]
June 23	do	18	14	1.23	1.82	[illegible]
November 14	W. E. Hall	19	17	.41	1.63	[illegible]

LITTLE RIVER AT CALHOUN, N. C.

This station was established July 19, 1904, for the purpose of making miscellaneous measurements. It is located at the highway bridge, about one-fourth mile from Calhoun post-office, N. C., and about 1 mile above the mouth of Little River.

The channel is curved for about 75 feet above and 100 feet below the station. The current is swift. The right bank is a high-rock cliff; the left bank is composed of earth, steep and wooded. Neither bank is liable to overflow. The bed of the stream is composed of rock along the right bank and of sand for the greater part of the distance. There is one channel at all stages, broken by one pier. Possibly a freshet in French Broad River would make a sluggish backwater at this station, but this is not liable to occur.

Discharge measurements are made from the upstream side of the two-span wooden bridge. The initial point for soundings is the right end of the upstream guard rail.

Bench marks were established as follows: (1) The upstream end of the horizontal strap binding the upstream guard rail to the girder, 31 feet from the initial point for soundings; elevation, 16.00 feet. (2) The upper edge of a small ledge of rock overhanging the water just under a point on the upstream side of the bridge, 6 feet from the initial point, marked by a nick in the rock on either side; elevation, 3.00 feet. Elevations refer to datum of assumed gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, page 111.

Discharge measurements of Little River at Calhoun, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	B. S. Drane	45	101	1.53	1.51	154
June 23	do	49	134	1.92	2.03	257
August 30	do	49	132	1.78	2.22	234

NORTH FORK MILLS RIVER AT PINKBED, N. C.

This station was established May 18, 1904, by M. R. Hall. It is located at the wagon bridge in the village of Pinkbed, N. C., about three-fourths of a mile below the post-office.

The channel is straight for about 200 feet above and below the station. The current is swift. Both banks are about 10 feet above low water and are not liable to overflow. There is a wide, level stretch of land from the left bank to the foot of the hill. The bed of the stream is composed of loose rock and is probably permanent. There is but one channel at all stages.

Discharge measurements are made from the single 39-foot span wagon bridge. The bridge rests upon log-crib abutments and the floor is about 10 feet above low water. The initial point for soundings is the edge of the crib abutment at the left bank, on the downstream side of the bridge.

The gage is a vertical timber 10 feet long, spiked to the log crib on the right bank at the upper side of the bridge. It is read once each day by J. T. Davenport. The gage is referred to bench marks as follows: (1) A nail driven into the bottom log of the crib on the right bank, at the downstream corner of the crib; elevation, 1.70 feet. (2) The center of a nail driven into a notch on a small poplar tree on the left bank about 40 feet above the bridge; elevation, 5.70 feet. Elevations refer to the datum of the gage.

A description of this station, gage height, and discharge data and rating table are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 112-114.

Discharge measurements of North Fork Mills River at Pinkbed, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	B. S. Drane	39	51	1.73	1.28	88
April 12	do	39	51	1.75	1.29	89
June 22	do	39	43	1.73	1.12	74
June 22	do	39	43	1.81	1.12	78
August 29	do	39	38	1.94	1.08	73
August 29	do	39	38	1.71	1.08	66
November 11	W. E. Hall	38	24	1.38	.68	33

Daily gage height, in feet, of North Fork Mills River at Pinkbed, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.55	0.65	1.1	0.9	0.9	1.0	1.6	1.1	1.0	0.8	0.7	[illegible]
2	.55	.65	1.1	.85	.9	1.0	1.3	1.05	1.05	.8	.7	[illegible]
3	.6	.6	1.1	.85	1.0	.9	1.15	1.05	1.0	.8	.7	[illegible]
4	.7	.6	1.1	.85	.95	.9	1.1	1.05	1.05	.8	.7	[illegible]
5	.7	.65	1.1	.95	1.25	.9	1.0	1.05	.9	.8	.7	[illegible]
6	.8	.7	1.05	.95	1.2	.9	1.1	1.05	.9	.8	.7	[illegible]
7	.8	.75	1.1	.9	1.15	.8	1.05	1.0	.9	.75	.7	[illegible]
8	.75	.75	1.1	.9	1.1	.85	1.1	1.0	.9	.75	.7	[illegible]
9	.7	.85	1.1	1.05	1.1	.8	1.0	1.1	.9	.7	.7	[illegible]
10	.6	.9	1.4	.9	1.05	.8	1.1	1.1	.9	.7	.65	[illegible]
11	.6	.8	1.15	.9	1.0	.8	1.9	1.4	.9	1.3	.65	[illegible]
12	2.5	.85	1.2	1.4	1.0	.8	4.0	1.6	.9	.8	.65	[illegible]
13	1.45	1.2	1.1	1.15	1.0	.8	2.4	1.5	.9	.8	.65	[illegible]
14	1.15	.85	1.1	1.1	1.0	.75	2.2	1.3	.85	.75	.6	[illegible]
15	.9	1.0	1.1	1.05	1.0	.75	1.9	1.25	.85	.75	.6	[illegible]
16	.85	.9	1.05	1.05	1.2	1.50	1.7	1.2	.8	.75	.6	[illegible]
17	.95	.8	1.0	1.05	1.1	1.7	1.6	1.15	.8	.75	.6	[illegible]
18	.8	.95	1.0	1.0	1.05	1.4	1.5	1.15	.8	.75	.6	[illegible]
19	.75	.8	1.0	1.0	1.0	1.3	1.5	1.15	.8	.75	.7	[illegible]
20	.75	.9	.9	1.0	1.0	1.3	1.5	1.1	.8	.75	.7	[illegible]
21	.7	1.25	1.25	.95	1.1	1.25	1.4	1.1	.9	.7	.7	[illegible]
22	.7	1.3	1.05	.95	1.0	1.15	1.4	1.05	.8	.7	.6	[illegible]
23	.7	1.4	1.05	.95	1.05	1.05	1.3	1.05	.8	.7	.6	[illegible]
24	.7	1.3	1.0	.9	1.05	1.0	1.3	1.2	.8	.7	.6	[illegible]
25	.65	1.25	1.0	.9	1.0	1.0	1.25	1.25	.8	.7	.6	[illegible]
26	1.0	1.2	.95	1.0	1.2	.95	1.2	1.35	.8	.7	.6	[illegible]
27	1.0	1.15	.9	.9	1.1	1.05	1.2	1.15	.8	.75	.6	[illegible]
28	.75	1.1	.9	.9	1.3	.95	1.2	1.1	.75	.75	.6	[illegible]
29	.65	.....	.9	1.05	1.2	.9	1.2	1.1	.75	.75	.6	[illegible]
30	.65	.....	1.0	.95	1.1	1.3	1.2	1.05	.8	.75	.6	[illegible]
31	.65	.....	.9	.....	1.05	.....	1.1	1.0	.....	.7	.....	.9

Station rating table for North Fork Mills River at Pinkbed, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	17	1.10	73	1.60	123	2.10	177
.60	26	1.20	83	1.70	133	2.20	188
.70	35	1.30	93	1.80	144	2.30	199
.80	44	1.40	103	1.90	155	2.40	211
.90	53	1.50	113	2.00	166	2.50	223
1.00	63						

NOTE.—The above table is based on seven discharged measurements made during 1905. It is well defined between gage heights 0.6 foot and 1.3 feet. Above 1.3 feet the table is roughly approximate.

Estimated monthly discharge of North Fork Mills River at Pinkbed, N. C., for 1905.

[Drainage area, 24 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	223	22	47.5	1.98	2.28
February	103	26	57.0	2.38	2.48
March	103	53	68.6	2.86	3.30
April	103	48	60.5	2.52	2.81
May	93	53	69.8	2.91	3.36
June	133	40	65.2	2.72	3.04
July	418	63	112	4.67	5.38
August	123	63	78.3	3.26	3.76
September	68	40	49.9	2.08	2.32
October	93	35	41.3	1.72	1.98
November	35	26	30.1	1.25	1.40
December	144	26	65.0	2.71	3.12
The year	418	26	62.1	2.59	35.23

SOUTH FORK MILLS RIVER NEAR SITTON, N. C.

This station was established May 18, 1904, by M. R. Hall. It is located at Sycamore Church, about 1 mile below Sitton's mill, Sitton, N. C.

The channel above curves about 90° in 500 feet and is straight for 200 feet below the station. The current is moderately swift, but may be rather sluggish above the station at low stages. Both banks are high and clean and are subject to overflow at extreme high water. The bed of the stream is composed of rock, and is clean and constant. There is but one channel at all stages.

Discharge measurements are made from a foot log about 150 feet above the ford. Owing to the overflowing of the banks discharge measurements can not be made at high water.

The gage is a vertical timber 10 feet long, spiked to a white-oak tree on the right bank of the river about 40 feet above the foot log. It is read once each day by W. E. Field. Bench marks were established as follows: (1) The center of two nail heads driven into the tree to which the gage is attached on the side next the river; elevation, 5.00 feet. (2) The center of nails in the root of a white-oak tree on the right bank, 50 feet below the gage; elevation, 5.00 feet. (3) Nails driven into a beech tree on the right bank, about 90 feet below the gage; elevation, 8.00 feet. (4) The head of a large nail driven vertically into a notch on the face toward the river of a 20-inch white-oak tree on the right bank, 25 feet above the gage; elevation, 9.94 feet. Elevations refer to the datum of the gage.

A description of this station, gage height, discharge data, and rating table are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 114–116.

Discharge measurements of South Fork Mills River near Sitton, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	B. S. Drane	37	87	1.80	1.44	[illegible]
April 12	do	37	86	1.85	1.44	[illegible]
June 22	do	40	86	1.56	1.28	[illegible]
June 22	do	40	86	1.53	1.29	[illegible]
August 29[a]	do	58	107	1.38	1.30	[illegible]
November 11[a]	W. E. Hall	45	32	1.78	.84	[illegible]
November 11[a]	do	24	27	2.26	.84	[illegible]

[a] Measured at different sections.

Daily gage height, in feet, of South Fork Mills River near Sitton, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.85	1.0	1.4	1.1	1.1	1.35	2.15	1.25	1.2	0.9	0.9	[illegible]
2	.9	1.0	1.4	1.1	1.1	1.3	1.65	1.2	1.3	.9	.9	[illegible]
3	.9	1.05	1.4	1.1	1.15	1.25	1.4	1.2	1.2	.9	.85	[illegible]
4	1.0	1.1	1.35	1.1	1.2	1.25	1.3	1.25	1.3	1.0	.85	1.25
5	1.0	1.1	1.4	1.2	1.75	1.2	1.25	1.2	1.15	.95	.9	[illegible]
6	1.25	1.2	1.35	1.2	1.7	1.15	1.5	1.2	1.15	.9	.9	[illegible]
7	1.25	1.2	1.4	1.1	1.55	1.1	1.25	1.15	1.1	.9	.9	[illegible]
8	1.05	1.9	1.4	1.1	1.4	1.1	1.4	1.15	1.1	.9	.85	[illegible]
9	1.3	2.15	1.35	1.2	1.4	1.05	1.25	1.4	1.1	.9	.85	[illegible]
10	1.0	1.45	1.85	1.15	1.35	1.05	1.35	1.5	1.05	.9	.85	[illegible]
11	1.0	1.3	1.6	1.1	1.3	1.05	2.7	2.5	1.05	1.7	.85	1.4
12	3.7	1.3	1.55	1.55	1.25	1.05	5.2	2.2	1.05	1.1	.85	1.25
13	2.15	1.5	1.5	1.4	1.2	1.05	3.3	1.7	1.05	1.0	.85	[illegible]
14	1.65	1.5	1.45	1.3	1.2	1.0	2.8	1.55	1.0	.95	.85	[illegible]
15	1.4	1.55	1.35	1.25	1.25	1.1	2.45	1.45	1.0	.9	.85	1.4
16	1.3	1.5	1.3	1.25	1.5	2.65	2.1	1.4	1.0	.95	.85	1.25
17	1.4	1.5	1.3	1.2	1.3	1.8	1.9	1.4	1.0	.9	.85	1.2
18	1.3	1.45	1.25	1.15	1.25	1.65	1.8	1.4	1.0	.95	.85	1.2
19	1.1	1.1	1.25	1.15	1.2	1.6	1.7	1.4	1.0	.9	.85	1.15
20	1.1	1.7	1.2	1.1	1.15	1.55	2.4	1.3	1.0	.9	.9	1.2
21	1.05	1.7	1.8	1.1	1.2	1.4	1.6	1.3	1.1	.9	.85	1.8
22	1.05	1.65	1.35	1.1	1.2	1.3	1.65	1.25	1.0	.9	.85	1.5
23	1.0	1.7	1.3	1.05	1.35	1.3	1.5	1.25	1.0	.9	.8	1.45
24	1.0	1.6	1.25	1.05	1.3	1.2	1.45	1.8	.95	.9	.8	1.4
25	1.0	1.5	1.25	1.05	1.2	1.15	1.45	1.68	.95	.9	.8	1.3
26	1.05	1.5	1.2	1.15	1.65	1.1	1.4	1.65	.95	.9	.8	1.25
27	1.05	1.4	1.2	1.15	1.7	1.2	1.35	1.45	.95	.95	.8	1.2
28	1.1	1.4	1.15	1.1	2.2	1.1	1.55	1.35	.95	.9	.8	1.3
29	1.05	.....	1.15	1.1	1.75	1.1	1.35	1.3	.9	.9	.8	1.35
30	1.05	.....	1.2	1.2	1.55	1.4	1.3	1.25	.9	.9	.8	1.25
31	1.0	.....	1.1	.....	1.45	.....	1.25	1.2	.....	.9	.....	1.2

Station rating table for South Fork Mills River near Sitton, N. C., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.8	55	1.7	206	2.6	375	3.8	626
.9	70	1.8	224	2.7	395	4.0	670
1.0	86	1.9	242	2.8	415	4.2	716
1.1	102	2.0	260	2.9	435	4.4	762
1.2	119	2.1	279	3.0	455	4.6	809
1.3	136	2.2	298	3.2	497	4.8	857
1.4	153	2.3	317	3.4	539	5.0	905
1.5	170	2.4	336	3.6	582	5.2	955
1.6	188	2.5	355				

NOTE.—The above table is based on seven discharge measurements made during 1905. It is well defined between gage heights 0.8 foot and 1.5 feet. The table has been extended beyond these limits. Above 1.5 feet the table is roughly approximate.

Estimated monthly discharge of South Fork Mills River near Sitton, N. C., for 1905.

[Drainage area, 40.5 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	604	62	126	3.11	3.58
February	288	86	159	3.93	4.09
March	233	102	146	3.60	4.15
April	179	94	112	2.77	3.09
May	298	102	151	3.73	4.30
June	385	86	134	3.31	3.69
July	955	128	236	5.83	6.72
August	355	110	159	3.93	4.53
September	136	70	93.9	2.32	2.59
October	206	70	77.7	1.92	2.21
November	70	55	61.7	1.52	1.70
December	375	55	141	3.48	4.01
The year	955	55	133	3.29	44.66

PIGEON RIVER NEAR WAYNESVILLE, N. C.

This station was established April 15, 1905, for the purpose of making miscellaneous measurements. It is located at Ironduff Bridge, 3½ miles above the mouth of Richland Creek, about 8 miles from Waynesville, N. C.

The channel is straight for 300 feet above and below the station. There is a good current. Both banks are high and not liable to overflow. The bed is partly of rock and partly of shifting sand. There is but one channel, broken by one pier. A large rock protrudes about 50 feet above the bridge and causes irregularities in the current.

Discharge measurements are made from the downstream side of the two-span bridge. The initial point for soundings is the left end of the bridge, downstream side.

The bench mark is on top of a steel plate bolted to the top of the lower chord over the downstream end of the first floor beam from the left of the bridge; elevation, 23.00 feet above datum of assumed gage.

Discharge measurements of Pigeon River near Waynesville, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 15	B. S. Drane	132	299	1.45	2.95	536
August 28	do	132	253	1.30	2.52	328

PIGEON RIVER AT NEWPORT, TENN.

This station was established September 4, 1900, by E. W. Myers. It is located at the highway bridge in the eastern part of Newport, Tenn., 1 mile from the railroad station and 1 mile above the dam of the Newport Flouring Mill, out of reach of backwater.

The channel is straight for about 300 feet above and 200 feet below the station. The section is deep, rough, and irregular in shape; the velocity is poorly distributed and about 50 feet of the total width at low stages is still water or has a negative velocity. The right bank is low and overflows to some extent, but all water passes beneath the bridge and its approach. The left bank is a high, vertical rock cliff. The bed of the stream is rocky near the left bank and sandy near the right bank.

Discharge measurements are made from the lower side of the single-span steel highway bridge. The initial point for soundings is the end of the hand rail over the left bank on the downstream side of the bridge. The section is better for measurement at the Southern Railway bridge, about 300 feet below, at which point some of the measurements have been made.

The original wire gage was replaced April 30, 1903, by a standard chain gage fastened to the lower chord of the bridge in the third panel on the downstream side. The datum of the two gages is the same; chain length, 29.94 feet. Since it was first established the gage has been damaged several times, and the records are continuous only from December 14, 1902. The gage is read once each day by S. R. McSween. Bench marks were established as follows: (1) The top surface of the outer left corner of the hanger plate at the bottom of the downstream end of the second floor beam from the left bank; elevation, 26.87 feet. (2) The top of a copper plug set in cement on the top of a limestone outcrop about 5 feet upstream and 3 feet to the left of the end of the upstream hand rail on the left bank; elevation, 32.61 feet. Elevations refer to datum of the gage. This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 188; 65, p 302; 83, pp 223-224; 98, pp 282-283; 128, pp 116-117, 155.
Discharge: 48, p 188; 65, p 302; 98, p 283; 128, pp 117, 155.
Discharge, monthly: 98, p 285; 128, p 119.
Gage heights: 48, p 188; 65, p 303; 98, pp 283-284; 128, p 118.
Rating table: 98, p 284; 128, p 118.

Discharge measurements of Pigeon River at Newport, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 9	B. S. Drane	164	1,415	3.35	4.28	4,737
May 11	W. E. Hall	130	925	.97	1.75	920
June 21	B. S. Drane	139	1,054	1.28	2.13	1,348
August 21	W. E. Hall	127	920	1.06	1.75	973
December 19	F. A. Murray	140	979	.89	1.63	865
December 26	do	141	1,036	1.28	2.03	1,325

Daily gage height, in feet, of Pigeon River at Newport, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.35	2.0	1.6	1.9	1.9	1.5	1.4	1.4	0.9	0.95	0.9
2	1.3	1.3	1.95	1.5	1.7	1.75	1.45	1.4	1.45	.95	.95	.95
3	1.4	1.2	1.8	1.5	1.6	1.6	1.45	1.35	1.45	.95	.9	4.1
4	1.45	1.05	1.75	1.55	1.6	1.6	1.3	1.35	1.4	1.0	.9	3.5
5	1.55	1.1	1.75	1.6	1.65	1.55	1.4	1.3	1.3	1.2	1.0	2.0
6	1.7	1.45	1.7	1.75	2.0	1.5	1.55	1.25	1.2	1.0	1.0	1.6
7	2.0	1.9	1.8	2.1	2.0	1.4	1.5	1.25	1.2	.9	1.0	1.7
8	1.5	1.7	1.9	2.0	2.0	1.5	1.45	1.35	1.2	.9	1.0	1.75
9	1.15	4.9	2.0	2.4	2.0	1.45	1.4	2.35	1.2	.9	.95	2.15
10	1.45	3.3	3.4	2.2	1.95	1.35	1.5	1.85	1.15	.9	.95	2.0
11	1.35	2.55	2.8	2.05	2.0	1.3	1.9	1.9	1.15	1.1	.9	1.9
12	5.0	2.5	2.3	2.6	1.7	1.3	7.6	3.15	1.15	1.15	.9	1.8
13	4.0	2.4	2.15	2.4	1.8	1.55	4.1	2.5	1.15	1.2	.9	1.7
14	2.8	2.55	2.1	2.2	1.8	1.35	2.9	2.3	1.1	1.1	.9	1.75
15	2.4	2.25	2.0	2.05	2.5	1.35	2.4	2.1	1.05	1.1	.9	1.75
16	2.3	2.1	1.9	2.0	3.9	1.4	2.1	2.0	1.05	1.05	.85	1.7
17	1.9	2.0	1.85	1.85	3.0	1.9	2.0	2.25	1.05	1.0	.85	1.7
18	1.8	1.95	1.85	1.8	2.35	1.8	2.0	2.45	1.0	.95	.8	1.65
19	1.75	1.85	1.8	1.75	2.1	1.6	2.0	2.0	1.0	.95	.8	1.6
20	1.65	4.0	2.0	1.7	2.0	1.55	1.9	1.9	1.2	1.0	1.0	1.6
21	1.55	5.0	2.25	1.7	1.95	2.1	1.85	1.75	1.3	1.2	1.1	1.95
22	1.5	3.8	2.1	1.7	2.1	1.8	1.85	1.75	1.2	1.1	1.1	2.2
23	1.4	3.1	1.95	1.65	2.7	1.85	1.8	1.7	1.05	1.0	1.05	2.0
24	1.2	3.0	1.9	1.6	2.2	1.75	1.75	1.8	1.05	.95	1.0	2.0
25	1.05	2.5	1.85	1.55	2.1	1.6	1.7	2.0	1.05	1.0	.9	2.0
26	.95	2.3	1.8	1.5	2.05	1.55	1.6	1.8	1.0	1.05	.9	1.9
27	.8	2.2	1.7	1.75	2.55	2.45	1.55	1.75	.95	1.1	.95	1.8
28	1.2	2.1	1.7	1.6	2.25	2.0	1.55	1.6	.95	1.2	.85	1.75
29	1.25	.....	1.6	1.65	2.1	1.75	2.0	1.5	.9	1.1	.85	1.6
30	1.25	.....	1.7	2.0	1.95	1.6	1.8	1.45	.9	1.0	.9	1.65
31	1.3	.....	1.7	.....	1.95	.....	1.65	1.4	.....	1.0	.....	1.65

Station rating table for Pigeon River at Newport, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.80	300	2.20	1,460	3.60	3,640	4.90	6,170
0.90	345	2.30	1,590	3.70	3,830	5.00	6,370
1.00	400	2.40	1,720	3.80	4,020	5.20	6,770
1.10	460	2.50	1,860	3.90	4,210	5.40	7,170
1.20	525	2.60	2,000	4.00	4,400	5.60	7,580
1.30	595	2.70	2,140	4.10	4,590	5.80	8,000
1.40	665	2.80	2,290	4.20	4,780	6.00	8,420
1.50	740	2.90	2,440	4.30	4,970	6.20	8,840
1.60	820	3.00	2,600	4.40	5,170	6.40	9,260
1.70	910	3.10	2,760	4.50	5,370	6.60	9,690
1.80	1,010	3.20	2,930	4.60	5,570	6.80	10,130
1.90	1,110	3.30	3,100	4.70	5,770	7.00	10,570
2.00	1,220	3.40	3,280	4.80	5,970	7.50	11,670
2.10	1,340	3.50	3,460				

NOTE.—The above table is based on discharge measurements made during 1904–5. It is fairly well defined between gage heights 1.6 feet and 4.5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Pigeon River at Newport, Tenn., for 1905.

[Drainage area, 655 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	6,370	300	1,111	1.70	1.9[illegible]
February	6,370	430	1,956	2.99	3.1[illegible]
March	3,280	820	1,220	1.86	2.14
April	2,000	740	1,080	1.65	1.8[illegible]
May	4,210	820	1,402	2.14	2.4[illegible]
June	1,790	595	1,211	1.85	2.0[illegible]
July	11,890	595	1,463	2.23	2.5[illegible]
August	2,845	560	1,068	1.63	1.8[illegible]
September	702	345	491	.750	.8[illegible]
October	525	345	419	.640	.73[illegible]
November	430	300	365	.557	.62[illegible]
December	4,590	345	1,177	1.80	2.08
The year	11,890	300	1,080	1.65	22.31

NOLICHUCKY RIVER NEAR GREENEVILLE, TENN.

This station was established May 7, 1903, by E. W. Myers. It is located at Jones's bridge, 5 miles southeast of Greeneville, Tenn., which is the nearest railroad station.

The channel is straight for about 700 feet above and below the station. The right bank is high, but at flood stages part of the water will pass around the end of the bridge. The left bank is high and can never overflow. The section is regular, and the bed is composed of gravel and is not subject to change. The velocity is uniform and well distributed except at extreme low water (below gage height 0.5 foot), when the middle pier and a small bar of gravel and small stones throw the current toward both banks.

Discharge measurements are made from the downstream side of the two-span steel highway bridge. The initial point for soundings is the left end of the top bar of the downstream hand rail.

A standard chain gage is bolted to the lower chord of the bridge on the upstream side midway between the second and third intermediate post from the right bank; length of chain, 33.63 feet. The gage is read once each day by B. H. Jones. Bench marks were established as follows: (1) A standard iron bench-mark post of the United States Geological Survey, set on the left bank just below the bridge, 5.5 feet downstream from the left end of the bridge; elevation, 26.80 feet. (2) The upper outer edge of the outer eyebar of the ower chord of the bridge, 3.6 feet to the right of the center of the third intermediate post from the right bank, marked by a spot of white paint and the letters "B. M.;" elevation, 32.03 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 285-286; 128, pp 119-120.
Discharge: 98, p 286; 128, p 120.
Discharge monthly: 98, p 287; 128, p 121.
Gage heights: 98, p 286; 128, p 120.
Rating table: 98, p 287; 128, p 121.

Discharge measurements of Nolichucky River near Greeneville, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 7	B. S. Drane	264	916	1.39	0.87	1,271
February 7	do	264	915	1.44	.87	1,323
May 15	W. E. Hall	266	1,263	2.76	2.19	3,486
June 15	B. S. Drane	265	818	1.13	.55	924
August 24	W. E. Hall	266	983	1.51	1.01	1,487
December 25	F. A. Murray	267	1,086	2.01	1.40	2,182

Daily gage height, in feet, of Nolichucky River near Greeneville, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.55	0.55	1.4	0.8	1.1	1.05	0.7	0.95	0.65	0.25	0.25	0.2
2	.55	.6	1.35	.7	1.0	.95	.7	.75	.65	.2	.25	.2
3	.7	.6	1.35	.7	.8	.85	.85	.7	.8	.35	.25	3.4
4	.9	.4	1.2	.7	.85	.7	1.05	.7	.15	.35	.2	2.6
5	.7	.5	1.2	.7	.9	.7	2.3	.7	.65	.4	.2	1.3
6	.65	.7	1.3	1.25	1.1	.65	.2	.7	.6	.35	.25	.8
7	1.15	.9	1.2	1.55	3.4	.65	1.0	.7	.5	.25	.3	.65
8	1.1	1.0	1.3	1.25	2.8	.65	.8	1.15	.5	.2	.25	.6
9	.7	2.6	1.4	1.35	2.4	.65	.7	1.75	.45	.25	.25	.8
10	.7	2.4	1.9	2.2	1.75	.55	.65	1.8	.45	.2	.2	2.6
11	.8	1.9	2.4	1.75	1.85	.5	.65	2.1	.4	.3	.2	1.6
12	1.3	1.5	1.85	2.7	1.7	.5	5.5	4.4	.4	.8	.15	1.15
13	4.0	1.5	1.7	2.4	1.6	.55	6.1	3.5	.6	.6	.2	.95
14	2.4	2.2	1.55	1.9	2.6	.7	3.1	2.8	.5	.35	.2	.8
15	1.75	1.5	1.4	1.55	2.2	.6	2.3	2.1	.4	.3	.15	.8
16	1.15	1.25	1.2	1.4	4.2	.5	1.8	2.05	.4	.25	.15	1.0
17	.95	1.2	1.2	1.25	3.6	2.6	1.85	1.75	.3	.25	.2	1.0
18	1.0	1.1	1.1	1.1	2.7	3.1	1.45	1.5	.35	.25	.2	.9
19	1.05	1.0	1.05	1.0	2.0	1.75	2.7	1.4	.35	.25	.15	.8
20	.95	2.1	1.05	.95	1.75	1.55	1.7	1.25	.35	.3	.2	.75
21	.85	4.2	1.1	.9	1.5	1.4	1.35	1.2	.35	.3	.25	.85
22	.8	3.6	1.2	.95	1.35	1.2	1.35	1.15	.35	.3	.25	1.8
23	.7	3.1	1.05	.9	1.65	1.1	1.45	1.0	.35	.3	.2	1.35
24	.6	2.4	.95	.8	1.7	1.05	1.25	1.0	.3	.25	.15	1.75
25	.65	2.0	.9	.75	1.4	.9	1.15	1.05	.25	.25	.15	1.5
26	.3	1.95	1.0	.7	1.25	.85	1.0	1.25	.25	.35	.15	1.15
27	.25	1.7	.9	.8	1.3	.85	.9	1.0	.2	.55	.2	1.0
28	.25	1.5	.8	1.0	1.3	.75	.9	.9	.2	.5	.2	1.15
29	.45	.....	.8	.9	1.9	.7	1.2	.7	.25	.4	.15	.8
30	.55	.....	.8	1.15	1.25	.7	1.15	.7	.2	.3	.2	.8
31	.55	.....	.85	.....	1.25	.....	1.15	.65	.....	.3	.....	.7

Station rating table for Nolichucky River near Greeneville, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	430	1.20	1,770	2.40	3,940	4.20	7,630
0.10	515	1.30	1,930	2.50	4,140	4.40	8,130
0.20	600	1.40	2,100	2.60	4,340	4.60	8,570
0.30	690	1.50	2,270	2.70	4,540	4.80	9,010
0.40	780	1.60	2,440	2.80	4,740	5.00	9,450
0.50	880	1.70	2,620	2.90	4,940	5.20	9,890
0.60	990	1.80	2,800	3.00	5,140	5.40	10,330
0.70	1,100	1.90	2,980	3.20	5,540	5.60	10,790
0.80	1,220	2.00	3,170	3.40	5,960	5.80	11,250
0.90	1,350	2.10	3,360	3.60	6,380	6.00	11,710
1.00	1,480	2.20	3,550	3.80	6,810		
1.10	1,620	2.30	3,740	4.00	7,250		

NOTE.—The above table is based on six discharge measurements made during 1905. It is fairly well defined between gage heights 0.5 foot and 2.2 feet. Beyond these limits it is uncertain.

Estimated monthly discharge of Nolichucky River near Greeneville, Tenn., for 1905.

[Drainage area, 1,099 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	7,250	645	1,513	1.38	1.59
February	7,690	780	2,604	2.37	2.47
March	3,940	1,220	1,872	1.70	1.96
April	4,540	1,100	1,852	1.69	1.89
May	7,690	1,220	2,909	2.65	3.06
June	5,340	880	1,543	1.40	1.56
July	11,940	1,045	2,650	2.41	2.78
August	8,130	1,045	2,230	2.03	2.34
September	1,220	600	815	.742	.828
October	1,220	600	722	.657	.757
November	690	558	604	.550	.614
December	5,960	600	1,820	1.66	1.91
The year	11,940	558	1,761	1.60	21.76

SOUTH FORK HOLSTON RIVER AT BLUFF CITY, TENN.

This station was originally established by the United States Weather Bureau at the highway bridge at Bluff City, Tenn. Readings were begun July 17, 1900, by the United States Geological Survey in connection with the general hydrographic investigation of the southern Appalachian region.

The channel is straight above the bridge for a distance of 300 feet, to the bridge of the Virginia and Southwestern Railway, and for about 1,000 feet below the bridge. The bed is rocky and permanent. The bottom is very rough, and rocky ledges just above and below the bridge cause back currents, eddies, and sudden variations in the velocity. Both banks are high and do not overflow.

Discharge measurements are made from the lower side of the four-span highway bridge. This bridge is a short distance below the Virginia and Southwestern Railway bridge. The initial point for soundings is the end of the guard rail on the downstream side of the bridge over the left abutment.

The gage, which is the property of the United States Weather Bureau, is a timber bolted to the downstream side of the first pier from the right bank. The gage readings are furnished by the United States Weather Bureau. The gage is referred to a United States Geological Survey bronze bench mark tablet set in the upstream side of the capstone of the left abutment; elevation, 20.44 feet above the zero of the gage and 1,389 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 48, p 182; 65, p 297; 83, p 227; 98, pp 287-288; 128, pp 122, 154.
Discharge: 48, p 182; 65, p 297; 83, p 227; 98, p 288; 128, pp 122, 155.
Discharge, monthly: 83, p 229; 98, p 290; 128, p 124.
Gage heights: 48, p 183; 65, p 298; 83, p 228; 98, pp 288-289; 128, p 123.
Rating tables: 65, p 323; 83, p 228; 98, p 289; 128, p 123.

Discharge measurements of South Fork Holston River at Bluff City, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 6	B. S. Drane	185	501	1.65	1.40	[a] 825
May 12	W. E. Hall	231	650	1.89	1.78	[a] 1,227
May 12	do	122	578	2.11	1.78	[b] 1,222
June 16	B. S. Drane	133	454	.88	.52	[b] 398
August 22	W. E. Hall	125	500	1.34	1.10	[b] 669
December 21	F. A. Murray	135	508	.88	.78	[b] 445
December 23	do	226	506	1.63	1.37	[a] 823

[a] Wagon bridge. [b] Virginia and Southwestern Railway bridge.

Daily gage height, in feet, of South Fork Holston River at Bluff City, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	0.9	2.4	1.2	1.8	1.3	0.7	2.0	1.3	0.3	0.3	0.4
2	1.0	.9	2.2	1.2	1.5	1.0	.6	1.6	.9	.3	.3	[illegible]
3	1.0	1.6	2.4	1.2	1.4	.9	.6	1.4	1.0	.4	.3	[illegible]
4	1.9	.5	2.4	1.1	1.3	.7	.6	1.0	1.5	.4	.3	[illegible]
5	1.4	1.0	2.4	2.6	1.2	.6	.7	1.0	3.2	.4	.3	[illegible]
6	1.5	1.4	2.3	3.7	1.9	.5	.9	1.7	2.0	.3	.3	1.5
7	1.8	1.7	2.3	3.4	2.2	.5	1.5	1.8	1.5	.3	.3	[illegible]
8	1.6	1.4	2.2	2.8	2.8	.8	1.3	2.0	1.3	.3	.3	1.0
9	1.3	5.4	2.9	2.4	2.6	.8	.9	1.7	1.0	.3	.3	[illegible]
10	1.5	3.4	4.5	2.2	2.2	.6	.7	1.6	1.0	.2	.2	1.6
11	1.3	2.8	4.4	1.9	1.8	.8	.8	1.5	.9	.5	.2	[illegible]
12	2.2	2.4	3.2	2.1	1.8	.8	1.2	1.8	.8	.6	.2	1.1
13	4.9	3.4	2.8	2.0	4.2	.7	6.2	2.1	.9	.5	.2	1.1
14	3.4	4.0	2.4	1.9	3.8	.6	3.1	2.0	.8	.4	.2	1.0
15	2.5	3.2	2.2	1.7	3.4	.6	2.4	1.8	.7	.3	.2	1.0
16	1.9	2.2	1.9	1.7	3.4	.5	1.7	1.8	.7	.3	.2	1.0
17	1.7	2.2	1.8	1.4	4.1	.7	1.4	2.6	.6	.3	.2	.9
18	1.8	1.9	1.7	1.6	3.3	.7	1.0	1.8	.5	.3	.2	.8
19	1.6	1.8	1.7	1.3	2.7	.8	1.5	1.5	.5	.3	.3	.8
20	1.4	1.9	1.6	1.2	2.2	.7	1.2	1.3	.4	.4	.3	.8
21	1.3	3.4	1.6	1.1	1.9	1.2	1.0	1.1	.4	.4	.3	.5
22	1.1	3.4	1.7	1.3	1.8	1.0	2.6	1.0	.5	.3	.3	.8
23	1.0	3.7	1.6	1.2	1.8	.7	3.8	1.0	.4	.3	.3	1.1
24	1.0	3.4	1.5	1.1	1.7	1.0	2.7	1.0	.4	.3	.3	2.0
25	.9	2.8	1.5	1.0	1.5	1.0	2.0	1.1	.4	.3	.3	1.9
26	.9	2.8	1.5	1.0	1.6	.8	1.7	1.9	.3	.4	.3	1.7
27	.9	2.6	1.4	1.1	1.4	1.0	.8	1.6	.3	.6	.3	1.4
28	1.0	2.6	1.4	1.8	1.2	1.1	1.4	1.4	.3	.4	.3	1.3
29	.8	.....	1.4	1.9	1.0	.8	1.7	1.0	.3	.4	.3	1.2
30	.8	.....	1.5	1.8	1.0	.8	3.4	.9	.3	.4	.3	1.1
31	.8	.....	1.4	.....	1.1	.....	2.8	.8	.....	.4	.....	1.0

Station rating table for South Fork Holston River at Bluff City, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	265	1.50	950	2.70	2,190	3.90	3,980
0.40	300	1.60	1,030	2.80	2,310	4.00	4,160
0.50	340	1.70	1,120	2.90	2,430	4.20	4,530
0.60	385	1.80	1,210	3.00	2,550	4.40	4,910
0.70	435	1.90	1,310	3.10	2,680	4.60	5,310
0.80	485	2.00	1,410	3.20	2,820	4.80	5,730
0.90	540	2.10	1,510	3.30	2,970	5.00	6,180
1.00	600	2.20	1,620	3.40	3,120	5.20	6,650
1.10	665	2.30	1,730	3.50	3,280	5.40	7,130
1.20	730	2.40	1,840	3.60	3,450	5.60	7,630
1.30	800	2.50	1,950	3.70	3,620	5.80	8,130
1.40	870	2.60	2,070	3.80	3,800	6.00	8,630

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 0.5 foot and 3.5 feet. The table has been extended beyond these limits. Above gage height 3 feet the table is the same as for 1904.

Estimated monthly discharge of South Fork Holston River at Bluff City, Tenn., for 1905.

[Drainage area, 828 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	5,950	485	1,105	1.33	1.53
February	7,130	340	2,115	2.55	2.66
March	5,110	870	1,656	2.00	2.31
April	3,620	600	1,237	1.49	1.66
May	4,530	600	1,674	2.02	2.33
June	800	340	493	.595	.664
July	9,130	385	1,404	1.70	1.96
August	2,070	485	997	1.20	1.38
September	2,820	265	574	.693	.773
October	385	235	289	.349	.402
November	265	235	256	.309	.345
December	2,820	265	855	1.03	1.19
The year	9,130	235	1,055	1.27	17.20

HOLSTON RIVER AT AUSTINS MILLS, TENNESSEE.

This station is maintained in cooperation with the United States Weather Bureau, by which the gage readings are furnished. It is located at the Southern Railway bridge at Austins Mills, Tennessee.

The channel is straight for about 2,000 feet above and for 1,000 feet below the bridge. The right bank will overflow gradually above gage height 10 feet, and the left bank above gage height 8 feet. There is a fringe of trees along both banks. The bed of the stream is composed of rock and gravel and is permanent. All the water passes beneath the bridge and trestles, there being one channel broken by three piers at ordinary stages.

Discharge measurements are made from the downstream side of the bridge. This is a deck bridge, 800 feet long, resting on stone piers. Six spans are wooden trusses, and piers have been built for two more spans at each end, but the track is carried on trestle work. The initial point for soundings is the end of the bridge truss over the center of the pier on the right bank, downstream side.

The gage is 49 feet long, and is attached vertically to the downstream end of the pier nearest the right bank. It is read once each day by Fred Beal.

A description of this station, gage-height and discharge data, and rating table are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 124–126.

Discharge measurements of Holston River at Austins Mills, Tennessee, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 10	B. S. Drane	414	2,904	4.32	5.30	12,550
May 16	W. E. Hall	412	2,796	3.89	4.87	10,880
June 20	B. S. Drane	383	1,590	1.57	2.05	2,489
August 25	W. E. Hall	373	1,592	1.47	2.25	2,347

Daily gage height, in feet, of Holston River at Austins Mills, Tennessee, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	1.8	3.5	2.4	2.7	2.3	1.8	3.4	2.0	1.5	1.5	1.4
2	2.1	1.8	3.3	2.3	2.5	2.3	1.7	2.7	2.6	1.5	1.5	1.4
3	2.2	1.9	3.2	2.3	2.3	2.1	1.7	2.4	2.3	1.5	1.5	[illegible]
4	2.6	2.0	3.4	2.2	2.3	2.0	1.7	2.2	2.3	1.5	1.5	[illegible]
5	2.9	1.8	3.2	2.2	2.2	2.0	1.7	2.1	2.6	1.5	1.4	[illegible]
6	2.4	1.9	3.2	3.0	2.2	2.0	1.7	2.2	3.1	1.5	1.4	3
7	3.5	2.5	3.3	4.0	3.0	1.9	2.3	2.4	2.4	1.5	1.4	[illegible]
8	3.2	2.8	3.1	3.8	3.6	1.9	2.2	2.4	2.2	1.4	1.4	[illegible]
9	2.7	5.5	3.4	3.6	4.1	1.9	2.0	3.5	2.1	1.4	1.4	2.4
10	2.3	6.0	5.8	3.5	3.5	2.0	2.0	3.3	2.0	1.4	1.3	2.3
11	2.5	4.8	6.3	3.2	3.1	1.8	1.9	3.3	2.0	1.4	1.3	[illegible]
12	3.1	4.0	5.2	3.4	3.0	1.7	1.8	3.8	1.8	1.5	1.3	2.4
13	5.9	4.2	4.3	3.8	3.2	2.1	6.3	3.8	1.9	1.7	1.3	[illegible]
14	5.6	5.6	3.8	3.5	5.3	2.0	5.7	3.7	2.0	1.6	1.3	[illegible]
15	4.2	4.5	3.4	3.2	5.5	1.9	3.9	3.4	1.9	1.6	1.3	[illegible]
16	3.4	3.9	3.1	3.0	4.8	1.9	3.2	3.2	1.8	1.5	1.3	2.0
17	2.9	3.4	2.9	2.8	5.9	1.8	2.6	3.1	1.8	1.5	1.3	2.0
18	2.7	3.3	2.9	2.6	5.3	2.0	2.6	3.3	1.7	1.5	1.3	2.0
19	2.6	3.0	2.7	2.5	4.7	2.0	2.3	2.8	1.7	1.5	1.2	2.0
20	2.6	3.0	2.6	2.4	3.6	2.1	2.5	2.5	1.7	1.5	1.2	1.9
21	2.4	4.6	2.5	2.3	3.2	2.2	2.3	2.3	1.7	1.6	1.2	[illegible]
22	2.4	5.2	2.5	2.3	2.9	2.2	2.2	2.1	1.6	1.5	1.2	2.0
23	2.2	5.2	2.5	2.5	3.1	2.0	3.2	2.1	1.8	1.5	1.2	[illegible]
24	2.1	5.0	2.5	2.4	3.1	2.0	4.0	2.5	1.7	1.5	1.2	3.2
25	2.0	4.3	2.4	2.2	2.8	2.3	3.3	2.2	1.7	1.4	1.2	3.2
26	1.8	4.0	2.4	2.2	2.5	2.2	2.7	2.3	1.7	1.5	1.2	3.0
27	2.0	3.8	2.4	2.1	2.5	2.3	2.4	2.5	1.7	1.6	1.2	2.6
28	2.2	3.5	2.4	2.1	2.4	2.1	2.2	2.4	1.6	1.6	1.2	2.4
29	2.2	.....	2.4	2.2	2.3	2.0	2.2	2.4	1.6	1.6	1.2	2.3
30	2.0	.....	2.4	2.5	2.2	1.9	2.6	2.3	1.5	1.6	1.4	2.1
31	2.0	.....	2.4	.....	2.2	.....	4.6	2.1	.....	1.5	.....	2.1

Station rating table for Holston River at Austins Mills, Tennessee, from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	645	1.70	1,695	2.30	3,035	2.80	4,380
1.20	805	1.80	1,900	2.40	3,285	2.90	4,675
1.30	970	1.90	2,110	2.50	3,545	3.00	4,980
1.40	1,140	2.00	2,330	2.60	3,815	3.10	5,290
1.50	1,315	2.10	2,555	2.70	4,095	3.20	5,610
1.60	1,500	2.20	2,790				

NOTE.--The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.1 feet and 2 feet. The table has been extended beyond these limits. Above gage height 3.2 feet the rating curve is a tangent, the difference being 330 per tenth. Below gage height 3.4 feet the table is the same as for 1904.

Estimated monthly discharge of Holston River at Austins Mills, Tennessee, for 1905.

[Drainage area, 3,060 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	14,520	1,900	4,393	1.44	1.66
February	14,850	1,900	7,417	2.42	2.52
March	15,840	3,285	5,749	1.88	2.17
April	8,250	2,555	4,363	1.43	1.60
May	14,520	2,790	6,051	1.98	2.28
June	3,035	1,695	2,406	.786	.877
July	15,840	1,695	4,353	1.42	1.64
August	7,590	2,555	4,307	1.41	1.63
September	5,290	1,315	2,271	.742	.828
October	1,605	1,140	1,341	.438	.505
November	1,315	805	990	.324	.362
December	11,550	1,140	3,593	1.17	1.35
The year	15,840	805	3,936	1.29	17.42

WATAUGA RIVER NEAR ELIZABETHTON, TENN.

This station was established May 11, 1903, by E. W. Myers. It is located on the Virginia and Southwestern Railway bridge at Siam, about 4 miles from Elizabethton, Tenn.

The channel is straight for 1,000 feet above and below the station. The right bank is high and will overflow only at flood stages. All water will, however, pass under the bridge and the trestle approach. The left bank is a perpendicular masonry abutment and will not overflow. The section underneath the bridge is smooth and consists of sand, silt, and some small rocks, and does not appear to be shifting. At ordinary stages the channel is divided into three parts by the bridge piers. At flood stages there is an additional flood channel on the right bank. A shallow stretch 1,000 feet below the bridge makes the current under the bridge sluggish at low stages.

Discharge measurements are made from the lower side of the bridge. The bridge crosses the river at an angle of about 14° with the normal to the direction of the current. The initial point for soundings is the top of the first bolt on the downstream guard rail over the middle of the left abutment.

A standard chain gage is fastened on the downstream side of the middle span on the inside of the guard rail; the zero of the scale is opposite a point 142 feet from the initial point for soundings; length of chain, 22.66 feet. The gage is read once each day by J. B. Nave. Bench marks were established as follows: (1) A standard copper bolt set in the cap of the abutment on the left bank, upstream side of the bridge; elevation, 21.11 feet. (2) The upper edge of the plate connecting the lower bracing system with the lower chord and floor beam opposite the middle of the gage box on the downstream side of the bridge; this floor beam is the fourth from the left end of the middle span; elevation, 19.60 feet. Elevations refer to the datum of the gage.

During the summer and fall of 1902 a line of levels was run from Carter station, Tennessee, near the mouth of the river, to a point near Shull's mill, in North Carolina, near the head of the river, locating the water powers of this stream. These powers are numerous and of considerable magnitude.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey reports as follows:

Description: 98, pp 290-291; 128, pp 126-127.
Discharge: 49, p 215; 98, p 291; 128, p 127.
Discharge, monthly: 98, p 292; 128, p 129.
Gage heights: 98, pp 291-292; 128, p 128.
Rating table: 98, p 292; 128, p 128.

Discharge measurements of Watauga River near Elizabethton, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 4	B. S. Drane	205	688	0.44	1.42	[illegible]
February 4	do	205	685	.45	1.41	[illegible]
May 13	W. E. Hall	209	1,127	2.01	3.61	[illegible]
June 17	B. S. Drane	207	644	.84	1.78	[illegible]
August 23	W. E. Hall	204	704	.95	1.93	[illegible]
December 22	F. A. Murray	207	787	1.12	2.24	[illegible]

Daily gage height, in feet, of Watauga River near Elizabethton, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.5	2.4	1.7	1.8	1.8	1.65	3.0	1.7	1.3	1.3	[illegible]
2	1.6	1.45	2.4	1.6	1.8	1.8	1.65	2.5	1.6	1.5	1.3	[illegible]
3	1.7	1.4	2.3	1.6	1.9	1.7	1.65	2.4	1.7	1.4	1.3	[illegible]
4	1.7	1.3	2.3	1.7	1.9	1.7	1.65	2.4	1.75	1.4	1.3	[illegible]
5	1.65	1.4	2.3	1.95	2.2	1.65	2.1	2.6	1.8	1.3	1.3	2.0
6	1.65	1.5	2.2	2.7	2.6	1.6	2.2	2.7	1.8	1.3	1.3	[illegible]
7	1.7	1.8	2.2	2.5	3.5	1.6	2.0	3.0	1.8	1.3	1.3	[illegible]
8	1.8	1.8	2.3	2.3	3.1	1.5	1.9	3.9	1.7	1.3	1.3	[illegible]
9	1.8	1.9	2.7	2.3	2.9	1.5	1.8	4.0	1.6	1.3	1.3	[illegible]
10	1.7	2.0	3.1	2.3	2.8	1.5	1.6	4.5	1.55	1.3	1.3	[illegible]
11	1.75	3.8	3.1	2.3	2.6	1.5	1.7	4.5	1.5	1.4	1.3	[illegible]
12	3.6	2.8	3.0	3.0	2.9	1.6	8.4	4.7	1.7	1.5	1.2	[illegible]
13	3.7	3.7	2.7	3.0	3.5	1.6	6.5	4.4	1.6	1.4	1.2	2.0
14	3.0	2.8	2.2	2.8	5.6	1.55	4.8	3.9	1.6	1.4	1.2	1.9
15	2.5	2.7	2.2	2.3	4.8	1.5	2.9	3.2	1.55	1.35	1.2	[illegible]
16	2.3	2.5	2.1	2.2	5.4	1.5	2.6	3.0	1.55	1.35	1.2	[illegible]
17	2.2	2.2	2.0	2.0	4.6	1.5	2.6	2.6	1.5	1.3	1.2	[illegible]
18	2.0	1.8	2.0	2.0	3.5	1.6	2.5	2.5	1.5	1.3	1.2	1.9
19	1.9	1.8	1.95	1.95	3.0	2.6	2.5	2.4	1.45	1.4	1.2	2.0
20	1.9	2.0	1.9	1.9	2.8	2.5	2.4	2.3	1.4	1.4	1.2	[illegible]
21	1.9	4.0	1.9	1.8	2.7	1.9	2.4	2.2	1.7	1.4	1.2	3.1
22	1.9	3.9	1.85	1.9	2.7	1.85	2.3	2.2	1.6	1.4	1.2	2.3
23	1.85	3.6	1.8	1.9	2.9	1.8	2.2	2.0	1.5	1.35	1.2	[illegible]
24	1.85	3.2	1.7	1.85	2.3	1.8	2.1	2.0	1.5	1.35	1.2	[illegible]
25	1.8	3.0	1.9	1.8	2.2	1.8	2.0	2.2	1.4	1.35	1.2	2.0
26	1.8	2.7	1.85	1.8	2.0	1.75	1.8	2.5	1.4	1.4	1.2	[illegible]
27	1.75	2.6	1.7	1.7	1.9	1.7	1.6	2.4	1.35	1.4	1.2	1.9
28	1.75	2.5	1.6	1.7	1.9	1.7	1.8	2.3	1.3	1.4	1.2	[illegible]
29	1.75	.....	1.6	1.9	1.9	1.7	2.5	2.0	1.3	1.4	1.2	[illegible]
30	1.75	.....	1.8	1.9	1.85	1.7	4.5	1.85	1.3	1.35	1.2	[illegible]
31	1.5	.....	1.7	.....	1.8	.....	3.8	1.7	.....	1.35	.....	[illegible]

[illegible] rating table for Watauga River near Elizabethton, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	130	2.20	835	3.40	2,070	5.20	4,570
1.10	165	2.30	920	3.50	2,200	5.40	4,880
1.20	205	2.40	1,010	3.60	2,330	5.60	5,200
1.30	250	2.50	1,100	3.70	2,460	5.80	5,520
1.40	300	2.60	1,190	3.80	2,590	6.00	5,840
1.50	355	2.70	1,285	3.90	2,720	6.20	6,180
1.60	410	2.80	1,385	4.00	2,850	6.40	6,520
1.70	470	2.90	1,490	4.20	3,110	6.60	6,860
1.80	535	3.00	1,600	4.40	3,390	6.80	7,200
1.90	605	3.10	1,710	4.60	3,670	7.00	7,540
2.00	680	3.20	1,825	4.80	3,970	7.50	8,440
2.10	755	3.30	1,945	5.00	4,270	8.00	9,340

NOTE.—The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.4 feet and 3.7 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Watauga River near Elizabethton, Tenn., for 1905.

[Drainage area, 408 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,460	355	712	1.75	2.02
February	2,850	250	1,140	2.79	2.90
March	1,710	410	827	2.03	2.34
April	1,600	410	765	1.88	2.10
May	5,200	535	1,558	3.82	4.40
June	1,190	355	494	1.21	1.35
July	10,100	410	1,509	3.70	4.27
August	3,820	470	1,536	3.76	4.34
September	535	250	389	.953	1.06
October	355	250	283	.694	.800
November	250	205	222	.544	.607
December	3,250	205	769	1.88	2.17
The year	10,100	205	850	2.08	28.29

DOE RIVER AT ELIZABETHTON, TENN.

This station was established May 22, 1904, for the purpose of making miscellaneous measurements. It is located at the covered wagon bridge in the town of Elizabethton, Tenn.

The channel is straight for 500 feet above and below the station. The current is extremely sluggish at low water. Both banks are high and do not overflow. All the water passes between the stone abutments of the bridge. The bed of the stream is composed of sand and is very shifting. There is but one channel at all stages. A low dam about 300 feet below the bridge will affect the flow considerably at low stages.

Discharge measurements are made from the downstream side of the bridge by lowering the meter between the sill and the edge of the floor. The initial point for soundings is the left bank end of the downstream hand rail.

The bench mark is the top of the lower downstream hand rail opposite the tension rods at the middle of the bridge, 65 feet from the initial point for soundings; elevation, 16.00 feet above datum of assumed gage.

A description of this station and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 129–130.

Discharge measurements of Doe River at Elizabethton, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 12	W. E. Hall	128	353	2.48	2.30	[illegible]
June 16	B. S. Drane	129	234	1.60	1.22	[illegible]
August 22	W. E. Hall	128	201	.79	.97	[illegible]
December 22	F. A. Murray	128	262	.61	1.55	[illegible]
December 22	do	128	270	.63	1.57	[illegible]

LITTLE TENNESSEE RIVER AT JUDSON, N. C.

Little Tennessee River rises in the extreme northeastern part of Georgia, with tributaries from the mountains between North Carolina and Georgia, and flows in a northwesterly direction, emptying into Tennessee River at Lenoir, Tenn. Measurements of flow are made at Judson, N. C., below the mouth of Sawyer Branch. The area drained is mountainous and covered with forest growth. The station was established in June, 1896, by E. W. Myers. It is located on the Southern Railway bridge, about one-fourth mile from Judson, N. C.

The channel is straight for several hundred yards above and below the station; the bottom rocky and very rough on the west side and sandy on the east side. The current is swift and considerably obstructed by two wide timber piers. The section is constant, but not a good one for measurements.

The original gage was a standard chain gage located on the downstream side of the first span from the left end of the bridge; length of chain, 26.29 feet. In 1905 a vertical gage was installed, two chains having been stolen from the chain gage. The vertical gage is in two sections; the first, reading from 1.5 feet to 6. feet, is bolted to a solid rock on the right bank, about 100 feet above the bridge. The second section, reading from 6 to 11 feet, is fastened to a maple tree about 30 feet downstream from the first section. This gage was set to read with the chain gage at a gage height of 3 feet, but owing to the large amount of slope in the river, the actual elevation of its zero is 0.50 foot above the datum of the chain gage. The gage is read once each day by J. L. Enloe. Bench marks were established as follows: (1) The top of the angle block on the lower chord at the middle of the first span from the left end of the bridge, on the downstream side; elevation, 22.86 feet. (2) A standard copper bolt set in the rock near the end of the tunnel on the right bank, 130 feet from the end of the bridge and 8 feet from the center of the track; elevation, 27.64 feet. Elevations refer to the datum of the vertical gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper; Bull=Bulletin):

Description: Ann 18, iv, pp 117–118; WS 15, p 62; 27, p 59; 36, p 168; 48, p 189; 65, p 305; 83, p 216; 98, pp 270–271; 128, p 130.

Discharge: Ann 18, iv, p 118, Bull 140, p 82; WS 15, p 62; 27, p 65; 36, p 168; 48, p 189; 65, p 305; 83, p 216; 98, p 271; 128, p 131.

Discharge, monthly: Ann 20, iv, p 207; 21, iv, p 163; 22, iv, p 224; WS 75, p 105; 83, p 218; 98, p 272; 128, p 132.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, p 42; 15, p 62; 27, p 63; 36, p 169; 48, p 190; 65, p 306; 83, p 217; 98, p 271; 128, p 131.

Hydrographs: Ann 20, iv, p 208; 21, iv, p 164; WS 75, p 105.

Rating tables: WS 27, p 66; 39, p 446; 52, p 515; 65, p 324; 83, p 217; 98, p 272; 128, p 132.

Discharge measurements of Little Tennessee River at Judson, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
pril 14	B. S. Drane	150	416	4.12	3.60	1,714
une 14	O. P. Hall	139	305	3.10	3.02	944
ctober 14	do	139	298	2.85	2.79	851

Daily gage height, in feet, of Little Tennessee River at Judson, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.95	3.0	3.9	3.35	4.1	3.4	3.15	3.0	2.4	2.5	2.55	2.65
2	2.9	3.0	3.9	3.3	3.65	3.4	3.2	2.6	3.2	2.55	2.5	2.55
3	2.1	2.9	3.7	3.25	.....	3.35	3.0	3.0	2.4	2.65	2.5	8.0
4	2.8	2.9	3.5	3.25	.....	3.25	2.9	3.5	3.0	3.5	2.5	3.85
5	2.7	2.75	3.4	3.25	.....	3.3	2.85	2.6	2.9	2.75	2.5	3.5
6	3.0	3.9	3.5	3.5	.....	3.25	2.9	3.5	2.85	2.6	2.5	3.3
7	3.95	3.55	3.4	3.35	4.2	3.15	3.2	2.9	2.9	2.5	2.5	4.8
8	3.1	3.45	3.5	3.3	4.0	3.25	2.75	2.25	2.8	2.5	2.5	3.4
9	2.7	8.0	3.4	3.4	4.0	3.1	2.9	3.5	2.8	2.5	2.5	6.9
10	3.1	5.1	4.3	3.45	3.6	3.1	3.0	3.35	2.75	2.6	2.5	6.0
11	3.1	4.4	4.2	3.45	3.5	3.1	4.3	4.4	2.25	3.85	2.45	4.8
12	8.2	4.0	4.1	3.85	3.45	3.15	7.6	6.1	2.9	3.6	2.45	4.2
13	6.3	4.9	4.0	3.9	3.45	3.1	5.8	3.8	2.8	3.65	2.45	3.95
14	4.8	4.7	3.9	4.2	3.35	3.0	4.4	3.75	2.45	2.9	2.45	3.8
15	4.1	4.3	3.6	3.4	3.35	3.0	4.4	3.95	2.45	2.75	2.4	3.9
16	3.55	3.8	3.6	3.6	4.8	3.1	4.3	3.4	2.7	2.8	2.4	3.9
17	3.45	4.0	3.5	3.45	4.1	3.2	4.0	3.55	2.7	2.7	2.4	3.85
18	3.5	3.8	3.5	3.35	4.0	3.1	3.6	3.45	2.65	2.6	2.4	3.65
19	3.4	3.7	3.45	3.35	3.6	3.4	3.9	3.1	2.65	2.6	2.4	3.5
20	3.35	4.0	3.45	3.25	3.5	3.15	3.6	3.1	2.65	2.6	3.0	4.7
21	3.3	6.8	4.4	3.25	3.5	3.2	3.3	3.0	2.7	2.6	2.7	3.35
22	3.2	5.8	4.1	3.35	3.5	3.35	3.3	3.35	2.6	2.6	2.5	3.35
23	3.1	5.1	4.1	3.25	3.5	3.85	3.35	3.7	2.6	2.55	2.5	4.5
24	3.0	4.8	3.8	3.15	4.0	3.2	3.05	3.75	2.5	2.5	2.5	4.8
25	2.95	4.4	3.65	3.1	3.5	2.75	3.2	3.1	2.5	2.55	2.5	4.4
26	2.95	4.2	3.5	3.2	3.5	3.0	4.3	3.4	2.5	3.0	2.65	4.1
27	2.9	4.1	3.45	3.6	4.5	3.2	3.0	3.3	2.5	3.8	2.5	3.9
28	2.85	3.9	3.45	3.45	3.45	3.25	2.95	3.3	2.5	2.6	2.45	3.8
29	2.85	.....	3.3	3.4	3.95	2.9	3.95	3.8	2.5	2.6	2.65	4.1
30	3.0	.....	3.5	4.6	3.95	3.0	3.85	3.1	2.45	2.55	2.9	3.8
31	2.9	.....	3.4	.....	3.95	.....	3.85	3.0	.....	2.55	.....	3.75

NOTE.—Readings July 1 to December 31 taken from vertical gage.

Station rating table for Little Tennessee River at Judson, N. C., from January 1, 1905, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	335	3.40	1,580	4.60	3,580	6.60	8,0[illegible]
2.30	405	3.50	1,720	4.70	3,780	6.80	8,540
2.40	485	3.60	1,860	4.80	3,980	7.00	9,050
2.50	575	3.70	2,000	4.90	4,180	7.20	9,590
2.60	675	3.80	2,140	5.00	4,380	7.40	10,1[illegible]
2.70	775	3.90	2,300	5.20	4,820	7.60	10,780
2.80	875	4.00	2,460	5.40	5,260	7.80	11,470
2.90	985	4.10	2,620	5.60	5,700	8.00	12,200
3.00	1,100	4.20	2,800	5.80	6,140	8.50	14,200
3.10	1,220	4.30	2,980	6.00	6,580	9.00	16,200
3.20	1,340	4.40	3,180	6.20	7,070	9.50	18,450
3.30	1,460	4.50	3,380	6.40	7,560	10.00	20,700

NOTES.—The above table is based on 40 discharge measurements made during 1896–1905. It is well defined between gage heights 2.2 feet and 5 feet. The table has been extended beyond these limits. Above gage height 10 feet the rating curve is a tangent, the difference being 480 per tenth.

Estimated monthly discharge of Little Tennessee River at Judson, N. C., for 1905.

[Drainage area, 675 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	13,000	275	1,909	2.83	3.2[illegible]
February	12,200	825	3,196	4.74	4.[illegible]
March	3,180	1,460	2,013	2.98	3.[illegible]
April	3,580	1,220	1,681	2.49	2.[illegible]
May [a]	3,980	1,520	2,150	3.19	3.[illegible]
June	2,220	825	1,326	1.96	2.[illegible]
July	10,780	825	2,177	3.23	3.[illegible]
August	6,825	370	1,694	2.51	2.[illegible]
September	1,340	370	734	1.09	1.2[illegible]
October	2,220	575	905	1.34	1.5[illegible]
November	1,100	485	602	.892	.9[illegible]
December	12,200	625	2,997	4.44	5.[illegible]
The year	13,000	275	1,782	2.64	35.7[illegible]

[a] Mean for 27 days taken as mean for month.

tation rating table for Little Tennessee River at McGhee, Tenn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	1,390	3.70	4,720	5.20	8,850	7.40	15,600
2.10	1,520	3.80	4,970	5.30	9,140	7.60	16,240
2.20	1,650	3.90	5,230	5.40	9,430	7.80	16,880
2.30	1.790	4.00	5,490	5.50	9,720	8.00	17,520
2.40	1,940	4.10	5,760	5.60	10,020	8.20	18,180
2.50	2,090	4.20	6,030	5.70	10,320	8.40	18,840
2.60	2,250	4.30	6,300	5.80	10,620	8.60	19,500
2.70	2,420	4.40	6,580	5.90	10,920	8.80	20,160
2.80	2,600	4.50	6,860	6.00	11,220	9.00	20,820
2.90	2,800	4.60	7,140	6.20	11,840	10.00	24,220
3.00	3,020	4.70	7,420	6.40	12,460	11.00	27,720
3.10	3,250	4.80	7,700	6.60	13,080	12.00	31,320
3.20	3,490	4.90	7,980	6.80	13,700	13.00	35,020
3.30	3,730	5.00	8,270	7.00	14,320	14.00	38,820
3.40	3,970	5.10	8,560	7.20	14,960		
3.50	4,220						
3.60	4,470						

NOTE.—The above table is based on six discharge measurements made during 1905. It is well defined between gage heights 2.2 feet and 5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Little Tennessee River at McGhee, Tenn., for 1905.

[Drainage area, 2,470 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	35,020	1,390	4,959	2.01	2.32
February	38,820	2,600	10,990	4.45	4.63
March	15,600	5,230	6,880	2.79	3.22
April	12,770	3,970	5.836	2.36	2.63
May	12,460	4,470	6,928	2.80	3.23
June	8,270	3,020	4,312	1.75	1.95
July	19,830	3,250	5,661	2.29	2.64
August	11,530	2,800	5,168	2.09	2.41
September	4,470	1,790	2,423	.981	1.09
October	7,420	1,650	2,363	.957	1.10
November	2,600	1,650	1,811	.733	.818
December	16,880	1,650	7,586	3.07	3.54
The year	38,820	1,390	5,410	2.19	29.58

TUCKASEGEE RIVER AT BRYSON, N. C.

Tuckasegee River rises in the southwestern part of North Carolina, at the base of Tennessee Ridge, which separates Jackson and Transylvania counties. It flows in a northwesterly direction, emptying into Little Tennessee River at Bushnell, N. C. Measurements of discharge are made at Bryson, N. C., 2 miles below the mouth of Newton Mill Creek. The drainage area is largely rough and mountainous and covered with forest growth.

This station was originally established in June, 1896, by E. W. Myers, at the Southern Railway bridge about 3 miles above Bryson, N. C., just below Governor Island post-office. This station was abandoned March 25, 1897, on account of the poor section. The present station was established November 7, 1897, at the highway bridge in the town of Bryson, N. C.

The channel is straight for about 600 feet above and below the station. The water is moderately swift, but the current is obstructed by the remnants of two old bridge piers. The right bank is low at the bridge and overflows to a slight extent, but all water passes beneath the bridge and its approach. The left bank is high and rocky and does not overflow. The bed is of gravel and sand and is fairly constant.

Discharge measurements are made from the sidewalk on the downstream side of the single-span steel highway bridge. The initial point for soundings is the end of the hand-rail at the left bank on the downstream side of the bridge.

The gage is a vertical rod bolted to the north pier on the right bank at the downstream side of the bridge. It is read once each day by J. M. Welch. The gage is referred to bench-marks as follows: (1) A copper bolt set in the stone sill beneath the large window in the northwest corner of D. K. Collin's brick store, about 80 feet east of the northeast corner of the county court-house; elevation, 22.30 feet. (2) A chisel mark on the top of the hand-rail on the downstream footway, 6 inches to the right of the post connected with the downstream end of the first floor beam from the right bank end of the main span; elevation, 21.50 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water Supply Paper; Bull=Bulletin):

Description: Ann 18, iv, pp 116-117; Bull 140, p 82; WS 15, p 61; 27, p 59; 36, p 167; 48, p 188; 65, p 304; 83, p 218; 98, p 273; 128, p 133.

Discharge: Ann 18, iv, p 117; Bull 140, p 82; WS 15, p 61; 27, p 65; 36, p 167; 48, p 189; 65, p 304; 83, p 218; 98, p 274; 128, p 134.

Discharge, monthly: Ann 20, iv, p 206; 21, iv, p 162; 22, iv, p 223; WS 75, p 104; 83, p 220; 98, p 275; 128, p 135.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, p 42; 15, p 61; 27, p 63; 36, p 168; 48, p 189; 65, p 305; 83, p 219; 98, p 274; 128, p 134.

Hydrographs: Ann 20, iv, p 206; 21, iv, p 162.

Rating tables: WS 27, p 66; 39, p 446; 52, p 515; 65, p 324; 83, p 219; 98, p 275; 128, p 135.

Discharge measurements of Tuckasegee River at Bryson, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	B. S. Drane	190	963	1.62	1.91	1,563
April 15	do	190	955	1.54	1.85	1,469
June 15	O. P. Hall	186	804	1.08	1.45	868
October 14	do	182	844	.71	1.20	602

Daily gage height, in feet, of Tuckasegee River at Bryson, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.3	2.0	1.65	1.8	1.7	1.7	1.5	1.4	1.1	1.1	1.1
2	1.3	1.35	2.0	1.6	1.7	1.7	1.7	1.45	1.7	1.1	1.1	1.2
3	1.5	1.3	1.9	1.6	1.75	1.65	1.5	1.45	1.65	1.4	1.1	5.2
4	1.2	1.2	1.85	1.6	1.8	1.6	1.5	1.45	1.45	1.3	1.1	2.1
5	1.3	1.4	1.9	1.9	1.8	1.6	1.45	1.5	1.4	1.15	1.1	1.7
6	1.5	2.0	1.9	1.8	2.1	1.6	1.8	1.45	1.35	1.1	1.2	1.55
7	1.55	1.7	2.0	1.7	2.3	1.6	1.6	1.5	1.35	1.1	1.15	1.5
8	1.3	2.4	2.1	1.65	2.1	1.5	1.6	2.3	1.3	1.1	1.1	2.0
9	1.4	3.7	3.8	2.0	2.0	1.45	1.5	1.8	1.3	1.1	1.1	3.9
10	1.35	2.8	3.6	1.8	1.85	1.4	1.7	2.7	1.3	1.3	1.1	2.5
11	1.4	2.4	2.5	1.75	1.8	1.4	3.1	3.3	1.3	2.65	1.1	2.0
12	6.4	2.3	2.4	2.35	1.7	1.55	5.2	2.8	1.5	1.4	1.1	1.9
13	3.45	3.3	2.2	2.1	1.75	1.45	3.2	2.4	1.3	1.25	1.05	1.7
14	2.5	2.5	2.1	1.9	1.75	1.4	2.8	2.3	1.3	1.2	1.05	1.7
15	2.05	2.3	2.0	1.85	2.0	1.45	2.6	2.1	1.25	1.2	1.05	1.9
16	1.85	2.1	1.9	1.8	3.1	1.7	2.2	2.0	1.25	1.2	1.05	1.75
17	1.8	2.0	1.9	1.7	2.3	1.55	2.1	2.1	1.2	1.15	1.05	1.7
18	1.7	1.8	1.85	1.7	2.1	1.6	2.0	1.95	1.2	1.15	1.05	1.6
19	1.6	1.8	1.8	1.65	2.0	1.9	2.05	1.8	1.25	1.15	1.1	1.6
20	1.55	4.0	2.0	1.7	1.9	1.8	2.0	1.8	1.2	1.3	1.3	1.75
21	1.5	3.8	2.8	1.6	2.0	1.8	1.9	1.75	1.2	1.15	1.15	1.55
22	1.45	3.2	2.15	1.6	2.0	1.8	2.25	1.65	1.2	1.15	1.1	1.95
23	1.4	2.9	2.05	1.6	2.5	1.8	1.9	1.8	1.15	1.1	1.1	3.0
24	1.4	2.6	2.0	1.55	2.2	1.65	1.8	2.0	1.1	1.1	1.05	2.2
25	1.2	2.5	1.9	1.5	2.05	1.6	1.7	1.75	1.1	1.55	1.1	2.0
26	1.2	2.3	1.85	1.7	2.1	1.5	1.65	1.7	1.1	1.3	1.1	1.9
27	1.5	2.2	1.8	1.7	2.0	2.2	1.6	1.6	1.1	1.3	1.05	1.8
28	1.5	2.1	1.75	1.6	1.95	1.75	1.8	1.55	1.1	1.2	1.05	1.9
29	1.5	.....	1.7	2.1	1.85	1.6	1.7	1.5	1.1	1.2	1.3	1.9
30	1.4	.....	1.8	1.95	1.9	1.6	1.6	1.5	1.1	1.1	1.3	1.7
31	1.35	.....	1.7	.....	1.85	.....	1.5	1.45	.....	1.1	.....	1.7

Station rating table for Tuckasegee River at Bryson, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	380	2.50	2,480	4.10	6,070	6.40	15,520
1.00	460	2.60	2,660	4.20	6,350	6.60	16,680
1.10	550	2.70	2,850	4.30	6,630	6.80	17,840
1.20	650	2.80	3,050	4.40	6,920	7.00	19,000
1.30	750	2.90	3,250	4.50	7,220	7.20	20,160
1.40	860	3.00	3,460	4.60	7,530	7.40	21,320
1.50	980	3.10	3,670	4.70	7,840	7.60	22,480
1.60	1,100	3.20	3,890	4.80	8,160	7.80	23,640
1.70	1,230	3.30	4,110	4.90	8,480	8.00	24,800
1.80	1,370	3.40	4,330	5.00	8,800	8.50	27,700
1.90	1,510	3.50	4,560	5.20	9,475	9.00	30,600
2.00	1,660	3.60	4,800	5.40	10,250	9.50	33,500
2.10	1,810	3.70	5,040	5.60	11,125	10.00	36,400
2.20	1,970	3.80	5,290	5.80	12,100	10.50	39,300
2.30	2,130	3.90	5,540	6.00	13,200	11.00	42,200
2.40	2,300	4.00	5,800	6.20	14,360		

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined to 3 feet.

Estimated monthly discharge of Tuckasegee River at Bryson, N. C., for 1905.

[Drainage area, 662 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	14,250	650	1,542	2.33	2.68
February	5,800	650	2,348	3.55	3.70
March	5,290	1,230	1,880	2.84	3.27
April	2,130	980	1,312	1.98	2.21
May	3,670	1,230	1,680	2.54	2.93
June	1,970	860	1,149	1.74	1.94
July	9,475	920	1,849	2.79	3.22
August	4,110	920	1,527	2.31	2.66
September	1,230	550	731	1.10	1.25
October	2,755	550	720	1.09	1.25
November	750	505	563	.850	.94
December	9,475	550	1,828	2.76	3.18
The year	14,250	505	1,427	2.16	29.24

HIWASSEE RIVER AT MURPHY, N. C.

This station was established July 26, 1896, by E. W. Myers. It is located at the highway bridge, Murphy, N. C., about 80 feet above the Atlanta, Knoxville and Northern Railroad bridge and one-half mile above the mouth of Valley River.

The channel is straight for about 500 feet above and below the station. The right bank is high and rocky and will not overflow. The left bank will overflow for a short distance around the abutment. The bed of the stream is rocky and rough, and makes soundings uncertain. The bed is permanent and the flow is rapid.

Discharge measurements are made from the sidewalk on the upstream side of the single span highway bridge. The bridge is 195 feet long, supported by stone abutments. The initial point for soundings is the end of the iron hand rail on the right bank, upstream side of the bridge.

A standard chain gage is fastened to the top of the downstream end of the first iron floor beam from the right bank in the space beween the bridge floor and the lower chords; length of chain, 27.05 feet. The gage is read once each day by William Mingus. Bench marks were established as follows: (1) The downstream side of the top of the stone pier at the right bank; elevation, 22.55 feet. (2) The top of the downstream end of the first iron floor beam from the right end of the bridge; elevation, 25.05 feet. (3) A cut with large nail on a large white-oak tree in the grounds of the Atlanta, Knoxville and Northern Railroad station, on the left side of the street leading from the highway bridge to the town and 325 feet from the end of the bridge; elevation, 31.57 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper; Bull=Bulletin):

Description: Ann 18, iv, p 118; 19, iv, p 259; WS 15, p 63; 27, p 60; 36, pp 169-170; 48, p 190; 65, p 306; 83, p 214; 98, p 268; 128, pp 135-136.

Discharge: Ann 18, iv, p 118; Bull 140, p 82; WS 15, p 63; 27, p 65; 36, p 170; 48, p 190; 65, p 306; 83, p 214; 98, p 268; 128, p 136.

Discharge, monthly: Ann 19, iv, p 260; 20, iv, p 209; 21, iv, p 165; 22, iv, p 224; WS 75, p 106; 83, p 216; 98, p 270; 128, p 138.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: WS 11, p 43; 15, p 63; 27, p 64; 36, p 170; 48, p 191; 65, p 307; 83, p 215; 98, p 269; 128, p 137.

Hydrographs: Ann 20, iv, p 209; 21, iv, p 165.

Rating tables: Ann 19, iv, p 259; WS 27, p 66; 39, p 446; 52, p 515; 65, p 324; 83, p 215; 98, p 269; 128, p 137.

Discharge measurements of Hiwassee River at Murphy, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 15	O. P. Hall	168	445	2.01	5.84	896
June 13	do	167	342	1.51	5.38	517
October 13	do	162	332	1.27	5.16	421

Daily gage height, in feet, of Hiwassee River at Murphy, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.25	5.3	5.8	5.55	6.3	5.7	5.85	5.2	5.15	5.0	5.0	5.2
2	5.2	5.25	5.8	5.55	6.05	5.65	6.0	5.2	5.25	4.95	5.0	5.15
3	5.45	5.2	5.7	5.5	5.9	5.55	5.45	5.15	5.3	5.0	5.0	10.0
4	5.4	5.2	5.6	5.5	5.9	5.55	5.35	5.15	5.2	5.5	5.0	6.5
5	5.35	5.2	5.6	5.65	5.8	5.5	5.65	5.2	5.15	5.1	5.0	5.9
6	5.35	5.95	5.6	5.65	6.1	5.5	5.4	5.15	5.1	5.0	5.0	5.65
7	5.8	5.75	5.6	5.7	6.2	5.5	5.45	5.15	5.1	5.0	5.1	5.55
8	5.5	5.7	5.6	5.6	6.7	5.45	5.35	5.35	5.1	5.0	5.0	5.55
9	5.45	8.75	5.6	5.7	6.05	5.4	5.35	5.35	5.1	4.95	5.0	8.7
10	5.4	6.95	6.1	5.65	5.9	5.4	6.35	5.25	5.05	5.0	5.0	7.0
11	5.4	6.3	6.0	5.6	5.8	5.35	6.55	6.3	5.15	7.55	5.0	6.35
12	5.5	6.1	5.8	5.85	5.75	5.4	10.3	5.8	5.15	5.45	5.0	6.05
13	6.6	7.0	5.8	5.85	5.9	5.35	6.85	5.75	5.1	5.2	5.0	5.85
14	6.55	6.3	5.7	5.75	5.7	5.4	6.15	6.3	5.1	5.1	5.0	5.75
15	6.6	6.3	5.6	5.7	5.65	5.3	5.85	5.9	5.05	5.1	5.0	5.85
16	5.8	6.0	5.6	5.8	7.2	5.4	5.8	5.75	5.05	5.2	5.0	5.8
17	5.65	5.9	5.6	5.7	6.45	5.5	5.65	5.6	5.05	5.1	5.0	5.7
18	5.6	5.8	5.6	5.65	6.1	5.4	5.55	5.5	5.0	5.05	5.0	5.65
19	5.5	5.7	5.55	5.6	5.95	5.6	5.6	5.45	5.0	5.05	5.0	5.6
20	5.6	6.2	5.65	5.55	5.85	5.5	5.5	5.4	5.0	5.05	5.35	5.65
21	5.45	8.2	7.0	5.55	5.8	5.5	5.4	5.35	5.0	5.05	5.15	6.6
22	5.4	7.2	6.25	5.65	5.85	5.8	5.5	5.3	5.0	5.0	5.1	6.2
23	5.35	6.6	6.05	5.5	6.45	6.75	5.4	5.25	5.0	5.0	5.05	6.15
24	5.35	6.4	5.9	5.5	6.95	5.55	5.35	6.5	4.95	5.0	5.0	6.4
25	5.3	6.2	5.85	5.45	6.35	5.55	5.4	5.5	4.95	5.0	5.15	6.1
26	5.25	6.1	5.75	5.5	6.2	5.35	5.3	5.6	4.95	5.3	5.2	5.95
27	5.25	6.0	5.7	5.9	6.1	5.35	5.3	5.35	4.95	5.15	5.1	5.8
28	5.2	5.9	5.65	5.8	5.95	5.45	5.35	5.3	4.95	5.1	5.1	5.75
29	5.15	.....	5.65	5.7	5.85	5.4	5.45	5.25	4.95	5.05	5.1	5.9
30	5.3	.....	5.65	6.95	5.8	5.55	5.3	5.2	4.95	5.05	5.2	5.7
31	5.2	.....	5.6	.....	5.95	.....	5.25	5.2	.....	5.0	.....	5.65

Station rating table for Hiwassee River at Murphy, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.80	190	5.60	710	6.30	1,540	7.00	2,740
4.90	235	5.70	800	6.40	1,690	7.10	2,930
5.00	285	5.80	900	6.50	1,850	7.20	3,130
5.10	340	5.90	1,010	6.60	2,020	7.30	3,330
5.20	400	6.00	1,130	6.70	2,190	7.40	3,540
5.30	470	6.10	1,260	6.80	2,370	7.50	3,750
5.40	540	6.20	1,400	6.90	2,550	7.60	3,960
5.50	620						

NOTE.—The above table is based on 62 discharge measurements made during 1900–1905. It is well defined between gage heights 4.8 feet and 6.8 feet. The table has been extended beyond these limits. Above 7.6 feet the rating curve is a tangent, the difference being 220 per tenth.

Estimated monthly discharge of Hiwassee River at Murphy, N. C., for 1905.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,020	370	695	1.70	1.96
February	6,600	400	1,602	3.91	4.07
March	2,740	665	907	2.21	2.55
April	2,645	580	815	1.99	2.22
May	3,130	755	1,282	3.13	3.61
June	2,280	470	664	1.62	1.81
July	10,500	435	1,102	2.69	3.10
August	1,850	370	647	1.58	1.82
September	470	260	307	.749	.836
October	3,855	260	449	1.10	1.27
November	505	285	316	.771	.860
December	9,550	370	1,518	3.70	4.27
The year	10,500	260	859	2.10	28.35

HIWASSEE RIVER AT RELIANCE, TENN.

This station was established August 17, 1900, by O. P. Hall. It is located at the Atlanta, Knoxville and Northern Railroad bridge, near the ferry landing at Reliance, Tenn.

Above the station the channel makes a sharp bend to the east for a distance of 800 feet. Below the station the channel makes a sharp bend to the west for about 1,000 feet. At ordinary stages the river is about 350 feet wide at this point, and the section is a fairly good one. The water is held back by a ledge of rock below, and is rather sluggish at low stages. Both banks overflow, but all water passes beneath the bridge and its approaches.

Discharge measurements are made from the railroad bridge and from the wooden trestles on both banks. The railroad track is about 34 feet above low water. The initial point for soundings is the center of the bridge pin about 1 foot from the end of the bridge on the right bank, downstream side. Discharge measurements at low stages can be made at a ferry near Wetmore, 6 miles below.

The gage is a vertical rod 10 feet long, fastened to an oak tree on the right bank 150 feet above the railroad bridge and 40 feet below the ferry landing and a 5-foot section, reading from 10 to 15 feet, attached to a sycamore tree on the downstream side of the road leading to the ferry, about 400 feet from the river. The gage is read once each day by C. V. Higdon. Bench marks were established as follows: (1) A cut in a hickory tree on the right bank of the river about 75 feet upstream from the bridge; elevation, 5.82 feet. (2) The top of the downstream iron girder under the cross-ties at a point about 40 feet from the end of the bridge on the right bank; elevation, 23.90 feet. (3) The top of the capstone of the right-bank pier on the upstream side of the bridge; elevation, 19.26 feet. (4) A copper plug set in a stone post flush with the surface of the ground at the south end of C. V. Higdon's house, under the south window. This house stands on the right bank, about 50 feet up from the foot of the hill, 600 feet north of the right-bank end of the bridge, and opposite a point on the river about 300 feet above the bridge; elevation of the bench mark, 27.16 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 48, p 191; 65, p 308; 83, p 210; 98, pp 262-263; 128, pp 138-139.
Discharge: Ann 19, iv, p 260; WS 27, p 45; 36, p 171; 48, p 191; 65, p 308; 83, p 210; 98, p 263; 128, p 139.
Discharge, monthly: Ann 22, iv, p 225; WS 75, p 107; 83, p 212; 98, p 265; 128, p 141.
Gage heights: WS 48, p 192; 65, p 309; 83, p 211; 98, p 263-264; 128, p 140.
Rating tables: WS 52, p 515; 65, p 324; 83, p 211; 98, p 264; 128, p 140.

Discharge measurements of Hiwassee River at Reliance, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	Olin P. Hall	318	2,103	1.12	1.98	2,347
June 19	do	311	1,927	.75	1.56	1,436
October 6	do	299	1,780	.40	1.07	708
October 7	do	301	1,794	.40	1.05	718
December 30	M. R. Hall	320	2,049	1.29	2.13	2,634

Daily gage height, in feet, of Hiwassee River at Reliance, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	De
1	1.4	1.4	2.05	1.8	2.5	1.9	2.2	1.3	1.2	0.95	1.1	[illegible]
2	1.4	1.4	2.0	1.75	2.3	1.85	2.0	1.25	1.35	1.0	1.1	[illegible]
3	1.5	1.35	1.9	1.7	2.2	1.85	1.8	1.25	1.4	1.05	1.1	[illegible]
4	1.75	1.5	1.85	1.7	2.15	1.7	1.55	1.2	1.6	1.6	1.1	[illegible]
5	1.5	1.9	1.85	1.8	2.0	1.65	1.45	1.2	1.25	1.55	1.1	[illegible]
6	1.5	2.15	1.8	1.9	1.95	1.65	1.6	1.2	1.2	1.15	1.1	[illegible]
7	2.4	2.1	1.75	1.85	2.3	1.6	1.75	1.2	1.25	1.05	1.1	[illegible]
8	1.9	2.15	1.75	1.8	2.2	1.55	1.5	1.5	1.15	1.0	1.15	[illegible]
9	1.65	7.2	1.85	1.8	2.4	1.55	1.6	1.6	1.1	1.0	1.1	[illegible]
10	1.55	3.9	2.5	1.95	2.2	1.5	1.4	1.45	1.2	1.0	1.1	[illegible]
11	1.6	2.85	2.5	1.8	2.0	1.45	1.5	2.05	1.15	1.8	1.15	[illegible]
12	2.9	2.4	2.2	2.0	1.9	1.45	2.3	2.3	1.2	2.2	1.1	[illegible]
13	5.0	2.8	2.15	2.2	1.9	1.5	3.3	2.0	1.3	1.45	1.05	[illegible]
14	5.5	3.2	2.0	2.0	1.95	1.45	2.4	1.8	1.2	1.3	1.05	[illegible]
15	3.1	2.7	1.95	1.9	1.8	1.45	2.05	1.8	1.1	1.2	1.05	[illegible]
16	2.1	2.4	1.9	2.0	3.2	1.45	2.05	1.9	1.1	1.2	1.05	[illegible]
17	1.9	2.25	1.8	1.9	3.0	1.6	1.8	1.4	1.1	1.25	1.05	[illegible]
18	1.8	2.1	1.8	1.8	2.5	1.55	1.9	1.9	1.05	1.15	1.05	[illegible]
19	1.75	2.0	1.8	1.75	2.2	1.55	1.8	1.6	1.05	1.2	1.05	[illegible]
20	1.65	2.7	1.8	1.75	2.0	1.75	1.75	1.55	1.15	1.15	1.15	[illegible]
21	1.65	6.3	2.1	1.7	2.0	1.75	1.65	1.4	1.15	1.15	1.35	[illegible]
22	1.6	3.9	2.9	1.8	2.0	2.0	1.7	1.3	1.1	1.1	1.25	[illegible]
23	1.55	3.2	2.3	1.7	2.3	2.0	1.6	1.3	1.0	1.1	1.15	[illegible]
24	1.5	2.4	2.1	1.6	3.7	2.0	1.45	2.0	1.0	1.1	1.1	[illegible]
25	1.45	2.6	2.1	1.6	2.7	1.7	1.35	2.0	1.0	1.1	1.1	[illegible]
26	1.5	2.25	2.0	1.65	2.4	1.55	1.45	1.6	1.0	1.15	1.2	[illegible]
27	1.45	2.25	1.95	2.15	2.3	1.5	1.35	1.5	1.0	1.3	1.2	[illegible]
28	1.35	2.15	1.9	2.3	2.1	1.7	1.35	1.5	1.0	1.25	1.15	[illegible]
29	1.4	.....	1.8	3.5	2.0	1.5	1.45	1.35	.95	1.25	1.15	[illegible]
30	1.5	.....	1.85	2.8	1.95	1.7	1.45	1.3	.95	1.15	1.3	[illegible]
31	1.45	.....	1.85	.....	2.0	.....	1.4	1.35	.....	1.15	.....	[illegible]

Station rating table for Hiwassee River at Reliance, Tenn., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	380	1.70	1,725	2.60	4,090	3.50	7,300
0.80	460	1.80	1,940	2.70	4,410	3.60	7,690
0.90	550	1.90	2,165	2.80	4,745	3.70	8,080
1.00	655	2.00	2,400	2.90	5,090	3.80	8,475
1.10	770	2.10	2,650	3.00	5,445	3.90	8,875
1.20	895	2.20	2,915	3.10	5,805	4.00	9,280
1.30	1,030	2.30	3,190	3.20	6,170	4.10	9,685
1.40	1,180	2.40	3,480	3.30	6,540	4.20	10,090
1.50	1,345	2.50	3,780	3.40	6,915	4.30	10,500
1.60	1,525						

NOTE.—The above table is based on 12 discharge measurements made during 1904–5 and 1 measurement made in 1901. It is well defined between gage heights 0.7 foot and 2.3 feet.

Estimated monthly discharge of Hiwassee River at Reliance, Tenn., for 1905.

[Drainage area, 1,180 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	15,440	1,105	2,680	2.27	2.62
February	22,700	1,105	4,886	4.14	4.31
March	5,090	1,832	2,446	2.07	2.39
April	7,300	1,525	2,320	1.97	2.20
May	8,080	1,940	3,174	2.69	3.10
June	2,400	1,262	1,640	1.39	1.55
July	6,540	1,105	1,912	1.62	1.87
August	3,190	895	1,504	1.27	1.46
September	1,525	602	832	.705	.787
October	2,915	602	976	.827	.953
November	1,105	712	803	.681	.760
December	15,440	962	3,846	3.26	3.76
The year	22,700	602	2,252	1.91	25.77

VALLEY RIVER AT TOMOTLA, N. C.

This station was established June 29, 1904, by M. R. Hall. It is located at a footbridge about 250 feet below a public-road ford at Tomotla, N. C., and 5 miles above Murphy, N. C.

The channel is straight for about 500 feet above and 1,000 feet below the station. The current is moderately swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of rock, but there is a fairly smooth and permanent section. There is but one channel at all stages.

Discharge measurements are made from the single-span footbridge, the floor of which is 10 to 15 feet above low water. The initial point for soundings is the upstream edge of the abutment, next to the water on the right bank.

The gage is a vertical timber 10 feet long, fastened to a pine timber which is spiked to the upstream side of a maple tree on the right bank about 50 feet below the ford. The gage is read once each day by J. T. Hayes. Bench marks were established as follows: (1) A cross on the head of a large spike driven into the downstream side of an elm tree about 10 feet upstream from the gage; elevation, 8.50 feet. (2) A cross on a point of rock at a spring on the right bank about 50 feet above the footbridge; elevation, 3.00 feet. Elevations refer to the datum of the gage.

A description of this station, gage height and discharge data, and rating table is contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 141–143.

Discharge measurements of Valley River at Tomotla, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
December 15	M. R. Hall	55	101	0.68	1.10	69
1905.						
April 17	O. P. Hall	58	150	1.36	1.79	204
June 16	do	56	125	.94	1.42	118
June 16	M. R. Hall	55	125	1.00	1.42	125
October 13	O. P. Hall	55	110	.71	1.20	78

Mean daily gage height, in feet, of Valley River at Tomotla, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.3	2.1	1.85	2.45	1.75	2.3	1.4	1.5	1.05	1.15	[illegible]
2	1.4	1.4	2.1	1.85	2.25	1.65	2.2	1.4	1.4	1.05	1.05	[illegible]
3	1.4	1.4	2.0	1.85	2.05	1.65	1.8	1.3	1.4	1.55	1.05	[illegible]
4	1.4	1.5	1.9	1.75	1.95	1.55	1.8	1.3	1.4	1.35	1.05	[illegible]
5	1.5	1.7	1.9	1.75	1.85	1.55	1.6	1.3	1.4	1.25	1.05	[illegible]
6	1.9	2.4	1.9	1.85	1.85	1.45	2.0	1.3	1.3	1.15	1.05	[illegible]
7	1.9	2.1	1.8	1.85	2.15	1.45	1.8	1.4	1.3	1.15	1.25	[illegible]
8	1.7	3.1	1.8	2.05	2.05	1.45	1.6	1.8	1.3	1.15	1.15	[illegible]
9	1.5	7.9	2.6	2.35	1.95	1.35	1.6	1.5	1.3	1.15	1.15	[illegible]
10	1.6	3.7	2.8	2.05	1.95	1.35	1.8	2.0	1.3	1.35	1.15	[illegible]
11	1.8	2.9	2.5	1.85	1.85	1.35	2.1	1.8	1.3	2.55	1.15	[illegible]
12	7.5	2.9	2.3	2.45	1.85	1.25	9.6	2.3	1.2	1.75	1.15	[illegible]
13	3.7	3.9	2.2	2.05	1.85	1.25	4.2	2.6	1.2	1.35	1.15	[illegible]
14	2.7	3.3	2.1	1.95	1.85	1.35	2.6	3.2	1.2	1.15	1.05	[illegible]
15	2.5	2.7	2.0	1.85	2.15	1.35	2.4	2.1	1.2	1.15	1.05	[illegible]
16	2.1	2.6	2.0	2.15	3.15	1.35	2.2	2.8	1.2	1.15	1.05	[illegible]
17	1.9	2.4	1.9	1.85	2.45	1.35	2.4	2.2	1.2	1.15	1.05	[illegible]
18	1.7	2.2	1.85	1.85	2.25	1.35	2.2	1.8	1.2	1.05	1.05	[illegible]
19	1.7	2.7	1.8	1.85	2.05	1.35	2.1	1.6	1.2	1.25	1.15	[illegible]
20	1.6	7.6	2.2	1.75	1.95	1.35	2.0	1.6	1.2	1.15	1.55	[illegible]
21	1.6	5.4	3.4	1.75	2.05	1.45	1.8	1.5	1.1	1.15	1.35	[illegible]
22	1.6	3.9	2.5	1.95	2.05	1.45	1.8	1.6	1.1	1.15	1.25	[illegible]
23	1.5	3.1	2.2	1.85	2.35	1.65	1.7	1.8	1.1	1.15	1.15	[illegible]
24	1.4	2.9	2.3	1.85	2.35	1.45	1.7	2.9	1.1	1.15	1.15	[illegible]
25	1.3	2.7	2.3	1.85	2.05	1.35	1.7	1.8	1.1	1.15	1.45	[illegible]
26	1.2	2.5	2.1	2.05	1.95	1.45	1.6	1.7	1.1	1.85	1.35	[illegible]
27	1.1	2.3	2.1	1.95	1.85	1.45	1.6	1.6	1.1	1.55	1.25	[illegible]
28	1.1	2.2	2.0	1.85	1.85	1.45	1.5	1.6	1.0	1.25	1.35	[illegible]
29	1.1	.....	2.3	2.85	1.85	2.85	1.5	1.5	1.1	1.15	1.75	[illegible]
30	1.2	.....	2.1	3.15	1.85	2.85	1.5	1.5	1.1	1.15	1.65	[illegible]
31	1.4	.....	1.9	.....	1.75	.....	1.5	1.4	.....	1.15	.....	[illegible]

NOTE.—The rating table for this station as published in the 1904 report applies quite closely for gage heights less than 2 feet.

NOTTELY RIVER AT RANGER, N. C.

This station was established February 16, 1901, by O. P. Hall. It is located at the wooden wagon bridge one-half mile from the railroad station at Ranger, N. C., and one-fourth mile below the Atlanta, Knoxville and Northern Railroad bridge.

The bridge is at a flat bend in the river, the channel curving slightly above and below the station for 600 feet. The right bank is high, rocky, and somewhat wooded and will overflow around the end of the bridge for about 50 feet only. The left bank is low and will overflow for a distance of 700 feet at a gage height of from 15 to 18 feet. The bed of the stream is of gravel and sand and probably shifts considerably. The current is somewhat broken and irregular, caused mostly by the piers. There is a moderate velocity and a depth of from 2 to 5 feet at low stages.

Discharge measurements are made from the wagon bridge, a wooden structure of 3 spans supported by 2 wooden piers and 2 stone abutments. The center span is 55 feet long, and the end spans are each 36 feet long. The floor of the bridge is about 20 feet above low water. The initial point for soundings is the inside face of the stone abutment on the right bank.

The gage is a vertical board in two sections, each 8 feet long, fastened to the left side of the first wooden pier from the right bank. The gage is read once each day by A. D. Kilpatrick. Bench marks were established as follows: (1) The heads of large wire nails driven into the top of the downstream end of the wooden cap on the left bent of the wooden pier nearest the right bank of the river; elevation, 20.05 feet. (2) A cut on a maple tree 18

inches in diameter, 25 feet from the upstream side of the bridge on the right bank, 25 feet from the edge of the water; elevation, 15.00 feet. (3) A cut on a red-oak tree about 15 inches in diameter, on the left bank of the river 35 feet from the end of the bridge near the downstream side of the road; elevation, 17.27 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 307; 83, p 212; 98, pp 265-266; 128, pp 143-144.
Discharge: 49, p 217; 65, p 307; 83, p 212; 98, p 266; 128, p 144.
Discharge, monthly: 75, p 106; 83, p 214; 98, p 267; 128, p 145.
Gage heights: 65, p 308; 83, p 213; 98, p 266; 128, p 144.
Rating tables: 65, p 324; 83, p 213; 98, p 267; 128, p 145.

Discharge measurements of Nottely River at Ranger, N. C., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	O. P. Hall	70	248	1.70	3.48	421
June 20	do	71	224	1.78	3.51	399
June 21	do	72	268	2.01	3.98	538
October 12	do	69	226	1.40	3.22	315

Daily gage height, in feet, of Nottely River at Ranger, N. C., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	2.9	3.7	3.3	3.9	3.5	3.9	2.7	3.4	2.8	2.6	2.6
2	2.9	2.9	3.6	3.3	3.8	3.3	4.1	2.7	3.1	2.3	2.6	2.7
3	3.5	2.9	3.6	3.3	3.7	3.5	3.6	2.7	3.0	2.8	2.7	11.8
4	3.1	3.0	3.6	3.2	3.6	3.4	3.4	2.7	3.0	3.0	2.7	4.8
5	3.1	2.9	3.6	3.4	3.5	3.3	3.1	2.7	2.9	3.0	2.7	3.2
6	3.1	4.0	3.5	3.5	5.8	3.2	4.2	2.6	2.9	3.0	2.6	2.9
7	3.0	3.9	3.5	3.6	5.6	3.2	4.1	2.8	2.8	2.9	2.6	2.7
8	3.5	5.4	3.5	3.5	5.2	3.2	3.9	2.7	2.8	2.5	2.6	9.9
9	3.1	10.2	3.4	3.5	4.9	3.1	3.1	3.1	2.6	2.5	2.6	7.2
10	3.0	5.2	4.7	3.4	4.2	3.0	3.0	3.9	2.4	2.4	2.6	5.8
11	2.9	4.3	4.1	3.4	4.0	3.0	4.5	3.9	2.4	6.6	2.6	4.2
12	11.4	4.2	3.8	3.8	3.8	3.0	9.0	4.0	2.6	3.8	2.6	4.0
13	7.2	5.9	3.9	3.7	3.7	3.0	5.0	4.2	2.5	3.2	2.5	4.0
14	5.3	4.6	3.8	3.6	3.5	3.0	4.1	3.9	2.5	2.8	2.5	3.9
15	5.1	4.2	3.5	3.5	3.5	3.1	3.9	3.4	2.4	2.5	2.5	3.9
16	4.5	4.0	3.5	3.9	6.6	3.1	3.3	3.3	2.4	2.5	2.4	3.4
17	4.5	3.8	3.5	3.5	4.9	3.2	3.5	3.3	2.4	2.5	2.4	3.5
18	3.4	3.6	3.4	3.4	4.2	3.0	3.3	3.2	2.4	2.6	2.3	3.5
19	3.3	3.7	3.4	3.4	3.9	3.3	3.2	3.0	2.4	2.6	2.3	3.4
20	3.3	4.0	3.5	3.4	3.8	3.4	3.4	3.0	2.3	2.6	2.3	4.6
21	3.3	7.8	7.5	3.4	3.6	4.0	3.3	2.9	2.3	2.6	2.3	5.9
22	3.2	5.2	4.8	3.5	3.4	3.9	3.2	2.8	2.3	2.6	2.4	5.1
23	3.2	5.0	4.4	3.4	5.3	5.0	3.0	2.8	2.3	2.5	2.4	5.0
24	3.1	4.7	4.2	3.3	5.0	3.6	3.0	2.8	2.4	2.5	2.4	5.4
25	3.0	4.6	3.7	3.3	4.7	3.4	2.9	2.7	2.4	2.5	2.3	5.2
26	3.0	4.4	3.6	3.4	4.3	3.4	2.8	2.6	2.4	3.2	2.4	4.9
27	3.0	3.9	3.6	4.4	4.0	3.3	2.7	2.6	2.3	2.8	2.5	4.7
28	2.9	3.8	3.5	3.8	3.9	3.3	2.8	2.7	2.3	2.7	2.5	4.6
29	3.4	.....	3.4	3.8	3.8	3.4	3.0	2.7	2.3	2.7	2.7	4.2
30	3.1	.....	3.4	4.6	3.6	3.2	3.0	2.6	2.3	2.6	2.7	4.0
31	2.9	.....	3.4	.....	4.0	.....	2.8	2.6	.....	2.6	.....	3.5

Station rating table for Nottely River at Ranger, N. C., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	101	2.60	184	3.00	272	3.40	373
2.30	120	2.70	206	3.10	295	3.50	402
2.40	141	2.80	228	3.20	320	3.60	432
2.50	162	2.90	250	3.30	346		

NOTE.—The above table is based on 22 discharge measurements made during 1901-1905. It is well defined between gage heights 2.25 feet and 3.5 feet. The table has been extended beyond these limits. Above gage height 3.6 feet the rating curve is a tangent, the difference being 32 per tenth.

Estimated monthly discharge of Nottely River at Ranger, N. C., for 1905.

[Drainage area, 272 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,992	250	501	1.84	2.12
February	2,544	250	716	2.63	2.74
March	1,680	373	506	1.86	2.14
April	752	320	420	1.54	1.72
May	1,392	373	640	2.35	2.71
June	880	272	364	1.34	1.50
July	2,160	206	455	1.67	1.92
August	624	184	288	1.06	1.22
September	373	120	174	.640	.714
October	1,392	120	247	.908	1.05
November	206	120	165	.607	.677
December	3,056	184	780	2.87	3.31
The year	3,056	120	438	1.61	21.82

OCOEE RIVER AT M'CAYS, TENN.

This station was established March 21, 1903, by O. P. Hall. It is located at a suspension footbridge just below McCay's ferry, at McCays, Tenn., near the Georgia-Tennessee boundary, and one-half mile below the railroad bridge of the Atlanta, Knoxville and Northern Railroad.

The channel is practically straight for about 800 feet above and below the station. The right bank will overflow at about 14 feet gage height for about 500 feet; the left bank will overflow at gage height 12 to 20 feet for about 400 feet. The water is confined to one channel and the bed is probably constant. The current is fairly swift and the section is good for measurement.

Discharge measurements are made from the suspension footbridge.

The gage is in two sections, the inclined section reading from —0.3 to 8.5 feet, set in a trench and held in place by posts driven into the ground. The vertical section, reading from 8 to 18 feet, is attached to the bridge posts on the right bank. The gage is read twice each day by Arch Ballew. Bench marks were established as follows: (1) A cut on a walnut tree on the downstream side of the road, about 50 feet from the left-bank landing of McCay's ferry; elevation, 12.59 feet. (2) The head of a large nail in the center of a post at the right-bank end of the footbridge on the downstream side; elevation, 16.10 feet. This post is an anchor post for the cable of the suspension bridge and may be pulled out of place. (3) A

pper plug set in solid rock at the outer edge of the side ditch of the railroad bed, about 800 et west of the railroad station at McCays, 11 feet north of the center of the track, and ghtly higher than the railroad; elevation, 20.98 feet. Elevations refer to the datum of e gage.

Information in regard to this station is contained in the following Water-Supply Papers the United States Geological Survey:

Description: 98, pp 259-260; 128, p 146.
Discharge: 98, p 260; 128, p 147.
Discharge, monthly: 98, p 262; 128, p 148.
Gage heights: 98, p 261; 128, p 147.
Rating table: 98, p 261; 128, p 148.

Discharge measurements of Ocoee River at McCays, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
April 10	O. P. Hall	148	477	1.4	1.22	666
June 19	do	150	460	1.32	1.18	608
October 5	do	143	369	1.12	.77	413

Daily gage height, in feet of Ocoee River at McCays, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.7	0.77	1.5	1.3	1.45	1.4	1.7	0.9	0.8	0.92	0.68	0.6
2	.7	.8	1.4	1.2	1.35	1.3	1.25	.82	1.7	.7	.6	.6
3	.7	.8	1.4	1.2	1.3	1.3	1.1	.8	1.1	.88	.6	4.6
4	.7	.75	1.4	1.2	1.5	1.25	1.0	.8	.92	1.2	.65	1.6
5	.63	1.0	1.3	1.4	1.4	1.2	1.0	.8	.8	.78	.62	1.4
6	.8	1.55	1.3	1.45	1.65	1.2	1.0	.75	.8	.68	.63	1.2
7	.5	1.25	1.4	1.4	1.7	1.2	1.0	.9	.8	.6	.62	1.2
8	.9	1.45	1.3	1.3	1.7	1.15	1.15	1.25	.8	.6	.6	3.6
9	.8	3.1	1.7	1.2	1.8	1.1	1.0	1.0	.8	.6	.6	3.4
10	.9	2.45	2.0	1.2	1.55	1.0	1.2	1.15	.72	.8	.6	2.4
11	.95	1.85	1.25	1.2	1.4	1.0	1.5	2.15	.75	3.3	.6	1.9
12	6.4	1.65	1.5	1.7	1.35	1.15	4.4	1.75	1.15	1.35	.6	1.65
13	3.5	1.7	1.55	1.35	1.3	1.1	2.0	1.65	.8	.95	.6	1.5
14	2.0	1.85	1.5	1.2	1.2	1.0	1.5	1.8	.73	.8	.6	1.55
15	1.1	1.75	1.4	1.35	1.55	1.5	1.3	1.95	.72	.82	.6	1.7
16	1.1	1.5	1.3	1.4	2.8	1.5	1.45	1.45	.72	.9	.6	1.6
17	1.1	1.5	1.3	1.2	1.8	1.65	1.3	1.4	.7	.8	.6	1.45
18	1.0	1.4	1.3	1.2	1.6	1.3	1.15	1.2	.7	.72	6	1.4
19	1.0	1.3	1.25	1.2	1.5	1.3	1.4	1.1	.65	.68	.55	1.35
20	1.0	4.2	1.7	1.15	1.5	1.1	1.2	1.0	.7	.6	.8	1.7
21	.98	4.1	3.0	1.15	1.45	1.4	1.1	1.0	.7	.65	.75	2.7
22	.93	3.3	1.95	1.25	1.4	1.25	1.1	1.0	.62	.62	.6	2.0
23	.9	2.25	1.7	1.1	3.0	1.85	1.0	1.1	.6	.65	.6	2.2
24	.83	2.15	1.7	1.1	2.2	1.25	1.0	1.1	.6	.6	.72	2.0
25	.8	2.0	1.6	1.1	1.85	1.2	1.05	1.15	.6	.7	.7	1.75
26	.8	1.85	1.5	1.25	1.8	1.15	.95	1.4	.6	1.2	.62	1.6
27	.75	1.65	1.4	1.7	1.7	1.3	.9	1.0	.55	.85	.62	1.55
28	1.1	1.55	1.4	1.45	1.6	1.5	.9	.95	.55	.75	.6	1.5
29	1.1	.....	1.35	1.5	1.5	1.8	2.15	.85	.55	.7	.65	1.7
30	.9	.....	1.45	1.85	1.45	1.65	1.0	.8	.58	.7	.75	1.5
31	.85	.....	1.3	.....	1.5	.....	1.0	.8	.....	.7	.....	1.45

Station rating table for Ocoee River at McCays, Tenn., from March 20, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	200	1.30	655	2.30	1,275	3.60	2,200
0.30	230	1.40	710	2.40	1,340	3.80	2,350
0.40	262	1.50	767	2.50	1,410	4.00	2,500
0.50	296	1.60	826	2.60	1,480	4.20	2,650
0.60	332	1.70	887	2.70	1,550	4.40	2,800
0.70	370	1.80	950	2.80	1,620	4.60	2,950
0.80	411	1.90	1,015	2.90	1,690	4.80	3,100
0.90	455	2.00	1,080	3.00	1,760	5.00	3,250
1.00	502	2.10	1,145	3.20	1,900	5.50	3,650
1.10	551	2.20	1,210	3.40	2,050	6.00	4,050
1.20	602						

NOTE.—The above table is based on 18 discharge measurements made during 1903–1905. It is well defined between gage heights 0.25 foot and 3.4 feet.

Estimated monthly discharge of Ocoee River at McCays, Tenn., for 1905.

[Drainage area, 374 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,370	296	649	1.74	2.01
February	2,650	390	1,012	2.71	2.82
March	1,760	628	786	2.10	2.42
April	982	551	663	1.77	1.98
May	1,760	602	859	2.30	2.65
June	982	502	661	1.77	1.98
July	2,800	455	687	1.84	2.12
August	1,178	390	592	1.58	1.82
September	887	314	401	1.07	1.19
October	1,975	332	459	1.23	1.42
November	411	314	344	.920	1.03
December	2,950	332	991	2.65	3.06
The year	4,370	296	675	1.81	24.50

FIGHTINGTOWN CREEK AT M'CAYS, TENN.

This station was established August 27, 1904, for the purpose of making miscellaneous measurements. It is located about one-half mile above the mouth of the creek which flows into Ocoee River about one-half mile below the gaging station on Ocoee River at McCays, Tenn.

Both banks are open cultivated lands, which will probably overflow. The bed is sandy and will probably change much.

Discharge measurements are made by means of a boat or by wading.

The bench mark is two small nails driven into the largest of a cluster of small maple sprouts on the right bank, 40 feet above the mouth of a small branch; elevation, 5.00 feet above datum of assumed gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 148–149.

Discharge measurements of Fightingtown Creek at McCays, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 20	O. P. Hall	42	138	0.89	2.00	123
October 6	do	40	114	.52	1.61	59

ELK RIVER NEAR ELKMONT, ALA.

This station was established June 24, 1904, by M. R. Hall. It is located at the wagon bridge near Wilson's store, about 5 miles east of Elkmont, Ala., and 3 miles below the bridge of the Louisville and Nashville Railroad.

The channel is nearly straight for about 1,500 feet above and straight for about 2,500 feet below the station. The current is swift. Both banks are high, cultivated, and liable to overflow. The bed of the stream is composed of rock, and is permanent. There is but one channel, broken by two piers at ordinary stages.

Discharge measurements are made from the downstream side of the bridge. This bridge is of iron, with stone abutments and cylindrical iron piers, having a span of 82 feet at the right bank, a main span of 181 feet, and two spans of 82 and 20 feet, respectively, at the left bank. The initial point for soundings is the end of the bridge at the right bank, downstream side.

A standard chain gage is attached to the upstream lattice iron fencing of the bridge about 125 feet from the right end; length of chain, 36.45 feet. The gage is read once each day by J. D. Tennison. Bench marks were established as follows: (1) A point marked with white paint on the top of the downstream pier at the right bank; elevation, 30.96 feet. (2) A chisel mark on the intermediate post at the end of the gage box, which is at the upstream end of the second floor beam from the right-bank end of the main span; elevation, 35.00 feet. (3) A copper plug set in the upstream corner of the right abutment; elevation, 29.33 feet. (4) A horizontal cut in the head of a lag screw driven into the downstream side of a large white oak tree, 6 feet upstream from the right end of the bridge and 50 feet back from the river; elevation, 25.00 feet. Elevations refer to the datum of the gage.

A description of this station, gage-height and discharge data, and rating tables are contained in Water-Supply Paper of the United States Geological Survey No. 128, pp. 150–152.

Discharge measurements of Elk River near Elkmont, Ala., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	W. E. Hall	235	629	2.20	2.71	1,382
June 19	F. A. Murray	232	590	1.96	2.51	1,157
September 30	do	201	360	.88	1.51	315
November 28	W. E. Hall	202	414	1.11	1.81	461

Daily gage height, in feet, of Elk River near Elkmont, Ala., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	2.9	4.0	3.1	4.0	3.2	13.2	2.1	1.8	1.7	2.6	2.1
2	3.2	3.1	3.8	3.0	3.7	3.1	11.6	2.05	3.5	1.8	2.5	1.9
3	3.0	2.8	3.6	3.0	3.3	2.85	6.9	2.0	5.2	2.5	2.4	3.2
4	2.9	2.9	3.4	3.1	3.0	2.7	4.7	2.0	3.0	2.25	2.35	3.4
5	2.75	3.15	3.1	3.3	2.9	2.6	4.4	2.0	2.5	1.9	2.25	2.8
6	2.6	8.3	3.2	3.4	2.8	2.5	4.0	2.0	2.0	1.8	2.2	2.7
7	2.75	5.9	3.1	3.1	3.4	2.4	3.6	2.3	2.0	1.7	2.15	2.6
8	2.65	8.0	3.0	3.0	3.9	3.1	4.1	2.2	2.0	1.6	2.1	3.2
9	2.65	8.2	8.9	2.9	3.3	3.2	3.7	2.0	1.9	1.5	2.1	3.7
10	2.55	14.8	13.1	2.85	3.2	3.0	3.5	2.3	2.0	1.7	2.0	3.5
11	3.2	10.2	10.6	2.8	3.1	2.9	3.7	4.5	2.7	6.5	2.0	3.4
12	11.1	7.7	7.4	2.7	2.9	2.7	4.3	3.0	2.2	5.2	1.9	3.2
13	11.5	7.1	5.4	2.7	2.8	2.6	3.8	2.7	1.8	3.0	1.9	3.2
14	6.1	6.6	4.6	2.65	2.7	2.45	3.7	2.4	1.7	2.4	1.85	3.1
15	5.5	5.9	4.2	2.6	2.5	2.3	3.1	3.2	1.7	2.6	1.8	8.4
16	4.6	4.7	3.8	2.55	3.0	2.7	3.0	2.5	1.7	2.6	1.9	8.7
17	3.7	4.5	3.6	2.4	3.3	3.6	2.8	2.35	1.65	2.4	1.8	6.2
18	3.5	4.3	3.5	2.35	3.4	3.0	2.7	2.3	1.6	2.2	1.75	5.2
19	3.4	4.0	3.6	2.3	3.5	2.6	2.5	3.0	1.55	2.2	1.8	4.5
20	3.6	11.6	5.9	2.25	3.4	2.6	2.4	2.3	2.4	3.3	1.8	4.2
21	3.4	15.6	6.2	2.2	3.1	2.7	2.3	2.1	2.7	4.3	1.95	6.6
22	3.2	13.1	6.3	2.7	3.0	8.2	2.2	2.0	2.0	3.2	1.85	8.2
23	3.1	11.1	5.9	2.8	10.5	8.5	2.4	1.9	1.9	2.7	1.8	12.4
24	2.8	8.0	5.2	2.7	7.2	5.8	2.3	1.9	1.7	2.5	1.8	8.4
25	2.6	6.0	4.6	2.6	12.6	5.2	2.2	2.2	1.6	2.7	1.75	7.2
26	2.5	5.4	4.0	2.55	7.0	4.5	2.2	2.4	1.6	5.3	1.75	6.0
27	2.5	4.7	3.8	3.0	5.5	3.9	2.2	2.2	1.6	5.0	1.8	5.4
28	2.4	4.2	3.6	3.3	4.2	4.9	2.0	2.1	1.6	3.4	1.8	5.4
29	2.6	.....	3.5	3.2	3.9	10.4	2.0	2.0	1.55	3.1	1.8	4.9
30	3.2	.....	3.3	4.3	3.5	9.5	2.0	1.8	1.7	2.9	2.0	4.2
31	3.0	.....	3.2	.....	3.3	.....	2.1	1.7	.....	2.7	.....	4.0

NOTE.—As far as it goes (1.2 to 3 feet) the 1904 rating table applies to the 1905 gage heights. But owing to the fact that there are so many gage heights beyond the range of the table, no estimates are made for 1905.

DUCK RIVER AT COLUMBIA, TENN.

This is an old Weather Bureau station which has not been maintained continuously. Two discharge measurements were made in 1901 by M. R. Hall. During 1904 discharge measurements were made, and the gage heights have been regularly recorded since October 21, 1904. The station is located at the highway bridge two blocks north of the public square at Columbia, Tenn., three-fourths of a mile below a milldam.

The channel is curved for about 1,000 feet above and nearly straight for 2,000 feet below the station. The current is sluggish above and swift below the measuring section. Both banks are high and fringed with trees. The right bank overflows under the short span of the bridge during floods. The bed of the stream is composed of rock and gravel, free from vegetation, and constant. There is but one channel, all water passing under the left span at ordinary stages and under both spans at high stages.

Discharge measurements are made from the downstream side of the two-span bridge. The spans are 199 and 97 feet long, respectively. Low-water measurements are made from a boat about one-fourth mile above the bridge. The initial point for soundings is the end of the bridge on the left bank, downstream side.

Gage readings were made from the United States Weather Bureau gage, a vertical timber 38 feet long bolted to the downstream pier at the right bank. June 17, 1905, a standard chain gage was fastened to the intermediate post and diagonal braces on the downstream side of the bridge 120 feet from the left end; length of chain, 53.71 feet. The gage is read twice each day by W. O. Cherry. Bench marks were established as follows: (1) A chisel mark on the right side of the intermediate post to which the gage is attached, 119 feet from the left end of the bridge; elevation, 53.71 feet. (2) A copper plug set in the downstream end of the left-bank abutment; elevation, 46.07 feet. (3) A cross and the letters "B. M." cut into solid rock 25 feet to the left of and 12 feet downstream from the left end of the bridge; elevation, 52.06 feet. Elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 128, pages 153–154.

Discharge measurements of Duck River at Columbia, Tenn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	W. E. Hall	115	772	0.69	1.21	533
June 16	F. A. Murray	134	823	.91	1.63	756
June 17	do	136	863	1.21	1.97	1,043
June 20	do	121	772	.78	1.34	599
September 29 [a]	do	86	95	1.42	.60	135
November 27	W. E. Hall	115	718	.33	.77	237

[a] Measured one-fourth mile above bridge.

Daily gage height, in feet, of Duck River at Columbia, Tenn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	0.45	2.5	1.55	1.9	2.25	10.2	0.6	0.8	0.45	1.45	1.2
2	2.5	.65	2.1	1.4	1.75	1.9	6.6	.6	2.05	.45	1.35	1.35
3	2.15	.7	1.8	1.3	1.45	1.75	4.2	.5	4.6	.9	1.25	3.8
4	1.7	.7	1.8	1.45	1.45	1.45	2.9	.55	1.9	.8	1.15	5.2
5	1.5	3.4	1.65	1.65	1.35	1.3	2.15	.55	1.4	.85	1.05	2.95
6	2.0	8.1	1.6	2.35	1.3	1.25	1.95	.55	1.1	.6	1.05	2.4
7	2.5	7.2	1.55	1.9	1.3	1.15	2.2	.65	.95	.6	.95	1.95
8	2.15	8.9	3.2	1.85	1.25	1.05	2.35	.6	.85	.55	1.0	1.75
9	2.2	17.2	17.8	1.55	1.2	1.0	2.7	.6	.7	.55	1.0	2.95
10	1.75	12.8	20.7	1.55	1.2	.95	1.95	1.35	.6	2.0	.9	3.4
11	2.4	7.6	12.8	1.45	1.15	1.0	3.2	4.2	1.2	3.2	.75	2.6
12	12.0	5.1	7.5	1.35	1.1	1.0	3.4	3.0	1.05	2.4	.75	2.2
13	14.0	4.6	5.2	1.3	1.15	.85	2.4	1.85	.7	1.7	.7	1.95
14	8.4	4.4	4.0	1.2	1.1	.85	1.8	1.9	.6	1.25	.8	2.0
15	4.8	3.7	3.3	1.15	1.1	1.45	1.5	3.6	.6	1.3	.6	9.2
16	3.4	3.1	2.9	1.1	1.2	2.75	1.4	3.4	.8	1.3	.65	11.4
17	3.0	2.7	2.65	1.05	2.05	2.0	1.1	1.95	.75	1.15	.65	7.0
18	2.5	2.5	2.35	1.0	2.35	2.2	1.0	1.5	.6	1.15	.65	4.8
19	2.4	3.0	2.15	1.0	2.1	1.6	.9	1.25	.55	2.4	.7	3.9
20	2.25	5.3	2.3	.95	1.6	1.3	.95	1.1	.8	4.0	.75	3.2
21	2.35	13.7	4.2	.9	1.45	1.8	.8	.95	.8	4.0	.75	5.2
22	2.0	11.5	5.2	.8	1.4	4.0	.85	.9	.65	2.5	.95	6.9
23	1.85	7.5	4.2	.9	21.6	11.4	.7	.85	.65	1.95	.9	9.0
24	1.7	5.4	3.3	1.0	29.3	10.4	.75	.85	.55	1.65	.8	9.4
25	1.55	4.4	3.0	1.0	27.7	4.7	.75	.9	.6	1.85	.85	6.4
26	1.3	3.6	2.7	1.0	13.9	3.5	.7	1.9	.55	4.6	.7	4.7
27	1.2	3.1	2.4	1.5	6.5	3.8	.7	1.35	.55	4.4	.75	3.6
28	1.2	2.8	2.1	1.7	4.4	3.7	.65	1.05	.55	2.95	.75	3.0
29	1.0	.....	1.95	1.5	3.2	7.9	.65	.8	.55	2.25	.8	2.8
30	.9	.....	1.7	2.15	2.7	7.5	.75	.55	.5	1.9	1.05	2.8
31	1.45	.....	1.6	.....	2.45	.....	.65	.75	.....	1.7	.....	2.4

MISCELLANEOUS MEASUREMENTS IN TENNESSEE RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Tennessee River drainage basin during 1905:

Holston River (North Fork) near Mendota, Va.—This stream is a tributary of Holston River, which is one of the largest of the streams which form Tennessee River. A measurement was made June 17, 1905, from the Virginia and Southwestern Railway bridge, 1 mile east of Mendota, Va. The bench mark is the apex of the downstream side of the cast-iron beam at third tension rod from left end of bridge, downstream side; elevation, 26.00 feet above the datum of the assumed gage.

Width, 115 feet; area, 315 square feet; mean velocity, 0.90 foot per second; gage height, 1.82 feet; discharge, 283 second-feet.

Pigeon River at Clyde, N. C.—This stream enters French Broad River from the left. A measurement was made April 16, 1905, from a single-span iron highway bridge at Clyde, N. C., about 1 mile above Morgan's mill.

Width, 128 feet; area, 297 square feet; mean velocity, 1.10 feet per second; gage height, 1.50 feet; discharge, 327 second-feet.

LOWER EASTERN MISSISSIPPI RIVER DRAINAGE BASIN.

The streams flowing into Mississippi River from the east below the mouth of the Ohio are in the main comparatively small. In the lower portion they are practically a network of bayous. The following pages contain the results of data collected in the lower eastern Mississippi River drainage by the United States Geological Survey during 1905:

YAZOO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yazoo River rises in the northwestern part of Mississippi. It flows southward just west of the central portion of the State and enters Mississippi River just above Vicksburg. The United States Geological Survey maintained a station on this river at Yazoo City during 1905 under the direction of M. R. Hall.

YAZOO RIVER AT YAZOO CITY, MISS.

River-height observations have been made on Yazoo River at Yazoo City, Miss., for a number of years, by the Engineer Corps of the Army.

The channel is straight for about 3,000 feet above the station and is curved for about 2,000 feet below. The current is moderately rapid. As this stream is connected with Mississippi River both above and below the station, it is influenced by the stage of that stream to such an extent that high-water measurements are of no value. The bed is of sand and mud, and is subject to change. The right bank is high, but overflows for a long distance at extreme floods; the left bank is high and overflows to the foot of the hill, about one-half mile from the river. There are trees along both banks.

Discharge measurements are made from the highway bridge, consisting of one span of 85 feet, a turn-span of 190 feet, an approach on the right bank of about 100 feet, and one on the left bank of about 1,200 feet. The bridge is one-half mile northwest of the Illinois Central Railroad station in Yazoo City. The initial point for soundings is the end of the iron bridge on the left bank, downstream side.

The original gage was replaced in 1901 by a new gage rod in three sections placed as follows: The lowest, marked from −3 to +4.5 feet, is attached to the protecting work of the above-mentioned highway bridge; the middle section, marked from 4.5 to 18.5 feet, is attached to the piling that protects the bridge pier; the uppermost section, continuing the graduation up to 32.3 feet, is on a post under the approach to the bridge. Daily gage heights are furnished by the Weather Bureau, the observer being P. C. Battaille.

A bench mark was established on the top of the upstream cylinder of the second pier from the left bank, at a distance of 85 feet from the initial point for soundings; elevation, 35.85 feet above the zero of the gage. Other important bench marks in Yazoo City are the following: P. B. M. 12, Yazoo City, is a copper bolt in a stone under ground, surmounted by an iron pipe and cap, in the north corner of the county court-house yard; elevation, 44.10 feet above the zero of the gage and 116.2 feet above mean sea level. P. B. M. 13, Yazoo City, is a copper bolt in a stone under ground, surmounted by an iron pipe and cap, in the north corner of the public school yard, near Washington and Main streets; elevation, 29.20 feet above the zero of the gage and 101.3 feet above mean sea level.

The highest known water occurred in 1882, reaching a gage height of 36.5 feet; the lowest occurred November 16–21 and 26–30, 1904, with a gage height of −3.0 feet. The danger line is at 25 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 287; 83, p 236; 98, pp 294–295; 128, p 158.
Discharge: 65, p 288; 83, p 236; 98, p 295; 128, p 159.
Discharge, monthly: 83, p 238; 98, p 297; 128, p 160.
Gage heights: 65, p 288; 83, p 237; 98, p 295; 128, p 159.
Rating tables: 83, p 237; 98, p 296; 128, p 160.

Discharge measurement of Yazoo River at Yazoo City, Miss., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 23	W. E. Hall	241	4,110	1.97	8.15	[illegible]

Daily gage height, in feet, of Yazoo River at Yazoo City, Miss., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.3	17.3	20.5	21.1	19.0	19.9	10.0	4.0	3.5	1.6	0.7	...
2	11.0	17.3	20.4	21.0	18.5	20.3	10.3	5.0	3.4	1.7	.7	...
3	11.6	17.4	20.3	20.9	18.1	20.9	10.5	4.8	3.2	1.8	.7	...
4	12.0	17.5	20.2	21.5	18.0	21.0	11.2	4.8	3.4	1.8	.8	...
5	12.4	17.6	20.0	21.0	17.5	21.0	11.4	4.8	2.9	1.0	1.7	...
6	12.9	18.3	20.0	21.0	17.2	20.9	11.7	4.3	2.8	.6	2.4	...
7	13.0	18.2	20.0	20.9	17.5	20.9	11.7	3.8	2.6	.0	2.3	...
8	13.2	19.5	20.0	20.8	17.5	20.7	12.1	3.4	1.0	−.6	2.0	...
9	13.3	19.9	21.0	20.7	17.8	20.6	12.5	3.0	.8	−.6	1.3	...
10	13.6	19.5	20.9	20.5	18.0	20.4	12.6	2.8	.0	−.6	1.4	...
11	14.0	19.5	20.9	21.0	18.3	20.0	12.7	2.7	.0	−.4	1.4	...
12	15.5	19.5	20.8	21.0	18.5	19.8	12.4	3.2	.0	−.3	1.0	...
13	15.5	20.0	20.8	21.0	18.7	19.4	12.2	2.8	.6	.0	.8	...
14	15.6	20.0	20.8	21.0	18.8	18.8	11.9	2.9	.4	.1	.8	...
15	15.8	19.8	20.8	21.0	19.0	18.0	11.4	3.0	.0	1.5	1.1	...
16	16.0	19.7	20.8	21.0	19.2	17.0	10.8	3.1	−.1	1.7	1.2	...
17	16.2	19.5	20.8	20.8	19.2	15.9	10.4	3.2	.0	1.3	1.3	...
18	16.3	19.5	20.8	20.4	19.2	14.5	9.7	3.4	.1	.9	1.3	...
19	16.5	20.0	21.2	20.2	19.3	13.2	9.2	3.4	−.2	−.2	1.1	...
20	16.5	21.2	21.5	19.8	19.3	11.5	8.7	3.6	.0	−.6	1.0	...
21	16.5	21.0	21.5	19.4	19.3	10.5	8.0	3.9	.0	−.9	1.0	...
22	16.5	20.9	21.5	19.0	19.9	9.5	7.5	3.9	.0	−1.2	.8	...
23	16.5	20.9	21.4	18.6	20.0	8.3	7.3	3.4	.0	−1.3	.6	...
24	16.6	20.9	21.4	18.4	19.9	7.5	7.0	3.1	.0	−1.4	.4	...
25	16.6	20.9	21.4	18.2	19.9	7.3	6.7	3.3	.0	−.6	.1	...
26	16.7	20.9	21.4	19.4	20.0	7.4	6.4	3.4	−.1	.0	−.2	...
27	16.7	20.9	21.3	19.0	20.2	9.0	6.4	3.0	−.3	−.1	−.4	...
28	16.7	20.7	21.2	18.8	20.4	8.3	6.0	3.0	−.4	−.1	−.8	...
29	16.9	...	21.5	18.5	20.5	9.4	5.7	3.2	.0	.0	−1.0	...
30	17.3	...	21.4	19.0	20.6	9.7	5.4	3.4	1.0	.2	−1.2	...
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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 169.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Union Trust Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Huntley, Mont.; Hazen, Nev.; Boise, Idaho; North Yakima, Wash.; Portland, Oreg., 351 Washington street.

Correspondence should be addressed to

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

MAY, 1906.

O

Water-Supply and Irrigation Paper No. 170 Series P, Hydrographic Progress Reports, 46

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART VI.—Great Lakes and St. Lawrence River Drainages

BY

R. E. HORTON, F. W. HANNA, and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART VI.

By R. E. Horton, F. W. Hanna, and John C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for fiscal years ending June 30, 1895, to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning

the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records in connection with short series of measurements serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided and the facts have been arranged so far as practicable geographically.

List of drainage basins in the United States.

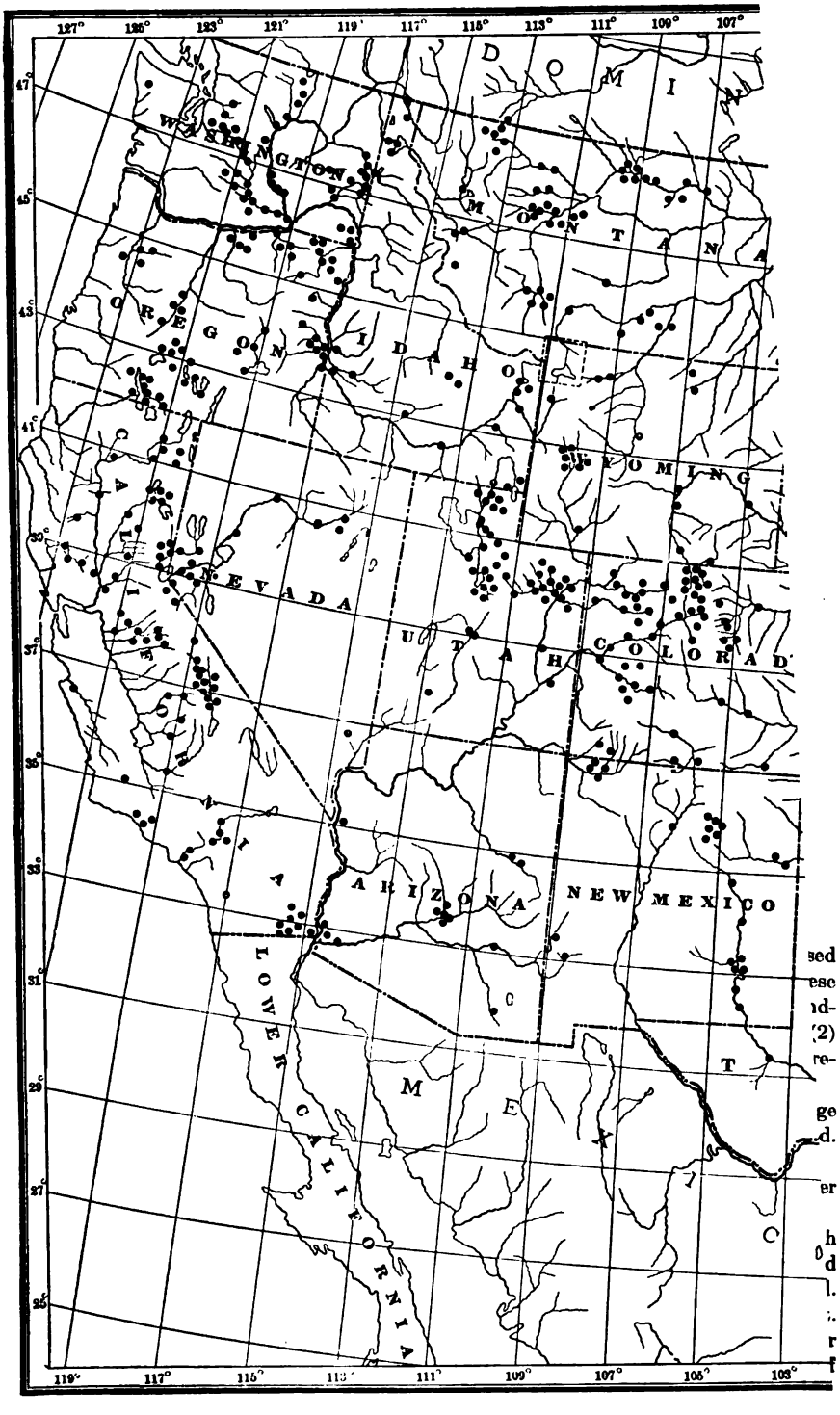
NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor southern Atlantic.

U. S. GEOLOGICAL SURVEY



MAP OF THE UNITED STATES, SHOWIN

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-foot. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly as regards both time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

An "acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, so far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the two remaining columns which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example. 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3 07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.

To calculate water power quickly, $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$=net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$: l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1: 125000, 1 mile=0.50688 inch.
Scale 1: 90000, 1 mile=0.70400 inch.
Scale 1: 62500, 1 mile=1.01376 inches.
Scale 1: 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{r\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of the water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q = c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured by a weir, a current meter, or a simple system of water wheels, which are of standard make, or have been rated as meters under working conditions, and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

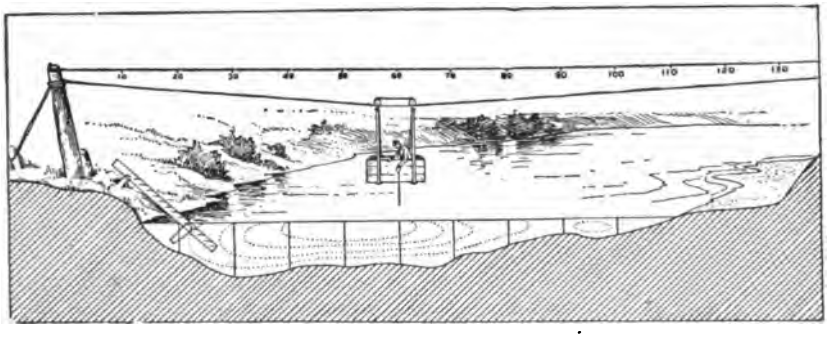


FIG. 1.—Cable station, showing section of the river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index to the discharge.

Certain permanent or semipermanent structures usually referred to as "equipment" are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurements, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats, as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared, which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurements an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points the vertical-velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and, moreover, the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point in the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141-148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

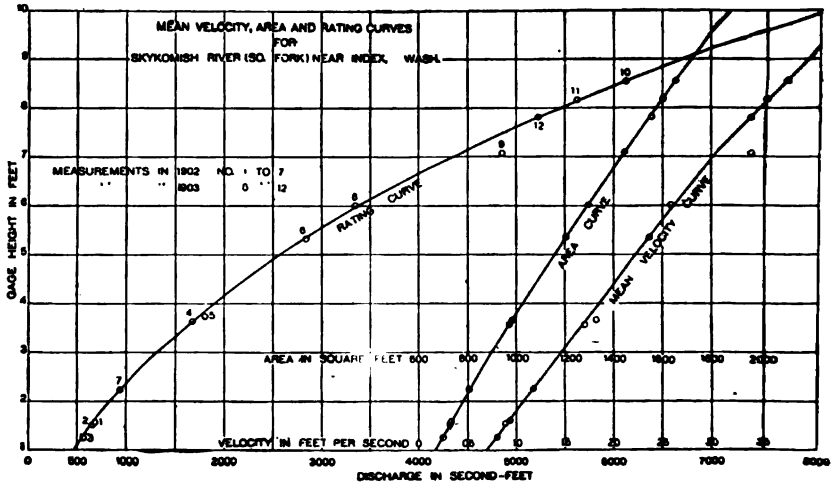


FIG. 2.—Rating, area, and mean-velocity curves for South Fork of Skykomish River, near Index, Wash.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient the discharge is computed for various heads and the rating table is constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river

at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve, with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors—the area and the mean velocity—any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height, or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and to corporations who

have assisted the local hydrographers in any way, either by furnishing records of the height of water or by supplying transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have aided in furnishing and preparing the data contained in this report:

Michigan (southern peninsula).—District hydrographer, R. E. Horton.[a] Records have been furnished by the following individuals and corporations: Kalamazoo Valley Electric Company, Kalamazoo, Mich.; Charles A. Chapin Electric Company, Buchanan, Mich.; Newaygo Portland Cement Company, Newaygo, Mich.; Fletcher Paper Company, Alpena, Mich.; George S. Pierson, Kalamazoo, Mich.; L. W. Anderson, city engineer, Grand Rapids, Mich.; Traverse City, Mich.; citizens of Sherman, Mich. Transportation has been furnished by the Au Sable and Northwestern Railroad. In the maintenance of gaging stations on Huron River a large part of the expense has been borne by the Washtenaw Electric Company, Ann Arbor, Mich. Acknowledgment is also due to Lyman E. Cooley, Chicago, Ill., and R. W. Hemphill, in connection with gagings on Huron River.

Michigan (northern peninsula).—District hydrographer, F. W. Hanna.[b] Acknowledgment is due W. J. Phillips for voluntary observations furnished at Iron River.

New York.—District hydrographer, R. E. Horton,[a] assisted by C. C. Covert. Records have been furnished by the following: E. A. Fisher, city engineer, and John F. Skinner, special assistant engineer, Rochester, N. Y.; T. P. Yates, Waverly, N. Y.; William S. Bacot, Utica, N. Y.; International Paper Company, Fort Edward, N. Y.; Schroon River Pulp and Paper Company, Warrensburg, N. Y.; Duncan Company, R. P. Bloss, Mechanicsville, N. Y.; George Beebe, deputy city engineer, Syracuse, N. Y. Special acknowledgment is made of the interest and assistance of William Pierson Judson, deputy State engineer.

Ohio.—District hydrographer, F. W. Hanna, assisted by M. S. Brennan and Sidney K. Clapp.

Vermont.—District hydrographer, H. K. Barrows,[c] assisted by T. W. Norcross. Acknowledgment should be made to Professors A. D. Butterfield and G. M. Brett, of the University of Vermont, for assistance rendered; to the Boston and Maine Railroad for trip passes issued to H. K. Barrows and T. W. Norcross; and to the Rutland Railroad and the St. Johnsbury and Lake Champlain Railroad for passes issued to H. K. Barrows.

LAKE MICHIGAN DRAINAGE.

GENERAL FEATURES.

The Lake Michigan drainage basin comprises a comparatively narrow strip of flat or gently rolling land in eastern Wisconsin, on the west shore of the lake, and a much wider strip of nearly the same character in Michigan, on the east shore. The principal streams entering the lake from the west are Fox and Menominee rivers; from the east St. Joseph, Kalamazoo, Grand, Muskegon, and Manistee rivers.

The following pages give the results of data collected during 1905 in the Lake Michigan drainage basin.

ESCANABA RIVER BASIN.

ESCANABA RIVER NEAR ESCANABA, MICH.

Escanaba River rises southwest of Lake Superior near Champion, in the upper peninsular of Michigan, flows southeastward for 70 miles, and enters Lake Michigan through Little Bay de Noc.

The gaging station was established in May, 1903. It is located at a highway bridge 4 miles above the mouth of the river.

The channel is nearly straight and is 194 feet wide between bridge abutments. The bed of the stream is covered with small bowlders and is rough but permanent. The current is swift. It is impossible to make discharge measurements in the winter as the channel is filled with ice, and during the logging season the logs give trouble.

Discharge measurements are made from the lower side of the single-span highway bridge to which the gage is attached. The initial point for soundings is the inner face of the right abutment.

During 1905 gage readings were made by Felix Beauchamp. The chain gage which was established in May, 1903, was replaced August 4, 1903, by a new standard gage, and the length of the chain was changed from 21.00 feet to 21.28 feet. The gage is referred to bench

[a] Office of district hydrographer for Michigan (southern peninsula) and New York, 75 Arcade, Utica, N. Y.

[b] Office of district hydrographer for Michigan (northern peninsula) and Ohio, 876 Federal Building, Chicago, Ill.

[c] Office of district hydrographer for Vermont, 6 Beacon street, Boston, Mass., rooms 808–809.

marks as follows: (1) The top surface of the steel abutment at the right end of the bridge, on the downstream side; elevation, 15.15 feet. (2) A nail in the root of a 5-inch birch tree about 200 feet east of the east abutment and about 50 feet downstream; elevation, 18.81 feet. Elevations are above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 484; 129, pp 17-18.
Discharge: 97, p 484; 129, p 18.
Discharge, monthly: 129, p 20.
Gage heights: 97, p 484; 129, pp 18-19.
Rating table: 129, p 19.

Discharge measurements of Escanaba River near Escanaba, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 12	S. K. Clapp	194	896	4.07	4.62	3,349
May 22	do	195	754	2.82	3.80	2,129
June 16	M. S. Brennan	194	689	2.32	3.49	1,595
July 14	do	194	455	1.09	2.37	497
August 14	do	194	455	1.07	2.35	487

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	4.4	2.9	3.1	2.6	2.4	2.1	2.6	2.8
2	4.5	4.3	2.8	3.0	2.5	2.5	2.2	2.6	2.8
3	4.4	4.3	2.8	2.9	2.6	2.6	2.4	2.7	3.1
4	4.3	4.4	3.1	2.9	2.7	2.5	2.3	2.6	3.1
5	4.3	4.3	3.8	2.9	2.7	2.6	2.2	2.7	3.0
6	4.2	4.6	4.0	2.9	2.8	2.4	2.3	2.7	2.9
7	4.0	4.4	4.1	2.8	2.8	2.6	2.4	2.8	2.8
8	3.9	4.3	4.0	2.7	2.9	3.0	2.3	2.7	2.9
9	4.0	4.0	3.8	2.7	2.9	2.9	2.3	2.8	2.8
10	4.1	4.0	3.6	2.6	2.8	2.9	2.4	2.8	2.8
11	4.1	4.0	3.5	2.5	2.7	2.8	3.0	2.7	2.7
12	4.3	4.1	3.5	2.5	2.7	2.5	2.3	2.7	2.8
13	4.3	4.1	3.5	2.5	2.6	3.0	2.3	2.6	2.6
14	3.8	4.0	3.4	2.4	2.7	2.5	2.4	2.5	2.6
15	4.0	4.1	3.5	2.1	2.7	2.4	2.4	2.7	2.7
16	3.8	4.1	3.4	2.2	2.6	2.4	2.3	2.7	2.6
17	3.3	4.2	3.4	2.2	2.5	2.4	2.3	2.6	2.6
18	3.2	4.2	3.3	2.2	2.4	2.3	2.4	2.5	2.7
19	3.5	4.1	3.4	2.3	2.4	2.7	2.5	2.6	2.7
20	3.6	4.1	3.5	2.4	2.3	2.8	2.7	2.7	2.6
21	3.5	4.0	2.3	2.4	2.2	3.7	2.8	2.6	2.6
22	3.5	4.1	2.5	2.5	2.1	2.6	2.8	2.5	2.8
23	3.8	3.5	3.0	2.6	2.0	2.8	2.7	2.5	2.8
24	3.9	3.4	2.9	2.4	2.0	2.6	2.6	2.4	2.9
25	4.1	3.3	3.0	2.5	2.0	2.7	2.5	2.4	3.0
26	4.2	3.2	3.1	2.5	2.0	2.4	2.9	2.5	2.9
27	4.1	3.2	3.4	2.4	2.0	2.3	2.9	2.4	2.9
28	4.3	3.2	3.5	2.5	2.0	2.3	2.8	2.6	2.8
29	4.4	3.1	3.4	2.6	2.0	2.2	2.8	2.6	3.0
30	4.3	3.0	3.2	2.7	2.0	2.2	2.8	2.7	3.0
31	.....	2.9	.....	2.6	1.9	.....	2.7	.....	3.1

Station rating table for Escanaba River near Escanaba, Mich., from April 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	140	2.60	680	3.30	1,455	4.00	2,435
1.90	200	2.70	770	3.40	1,580	4.10	2,590
2.00	260	2.80	860	3.50	1,710	4.20	2,745
2.10	320	2.90	960	3.60	1,845	4.30	2,905
2.20	385	3.00	1,080	3.70	1,985	4.40	3,065
2.30	450	3.10	1,205	3.80	2,130	4.50	3,225
2.40	520	3.20	1,330	3.90	2,280	4.60	3,390
2.50	600						

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 2 feet and 4.6 feet. Above gage height 4.6 feet the rating curve is a tangent, the difference being 170 per tenth.

Estimated monthly discharge of Escanaba River near Escanaba, Mich., for 1905.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	3,390	1,330	2,468	3.08	3.44
May	3,390	960	2,322	2.90	3.34
June	2,590	450	1,512	1.89	2.11
July	1,205	320	669	.836	.964
August	960	200	565	.706	.814
September	1,985	385	708	.885	.987
October	1,080	320	623	.779	.898
November	860	520	699	.874	.975
December	1,205	680	891	1.11	1.28

MENOMINEE RIVER BASIN.

MENOMINEE RIVER NEAR IRON MOUNTAIN, MICH.

Menominee River begins at the junction of Brule and Michigamme rivers, in the extreme southeastern part of Iron County, Mich., in T. 41 N., R. 31 W., flows in a general southeasterly direction, and enters Lake Michigan through Green Bay. It forms, throughout its length, a part of the boundary between Wisconsin and the upper peninsula of Michigan.

The gaging station was established September 4, 1902. It is located at the Homestead highway bridge, 3.5 miles south of Iron Mountain, Mich.

The channel is straight and has a width of 220 feet between abutments. Both banks are high and not liable to overflow. The bed of the stream is composed of gravel and small bowlders. The current is moderate. Log jams give trouble and during the winter the river freezes beneath the bridge so that it is difficult to obtain measurements.

Discharge measurements are made from the single-span bridge, to which the gage is attached. The initial point for soundings is the face of the right abutment and is marked zero on the guard rail.

The gage, which was read during 1905 by Theodore Moll, was originally a vertical board fastened to the right abutment. November 18, 1904, a chain gage was established, with the same datum as that of the board gage and with a length of 28.19 feet from the end of the weight to the outside of the ring. The bench mark is the top of the 12-inch timber bridge seat on the right abutment over the gage; elevation above zero of gage, 22.68 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 257-258; 97, pp 474-475; 129, p 20.
Discharge: 83, p 258; 97, p 475; 129, p 21.
Discharge, monthly: 129, p 23.
Gage heights: 83, p 258; 97, p 475; 129, p 21.
Rating table: 129, p 22.

Discharge measurements of Menominee River near Iron Mountain, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 12	S. K. Clapp	220	2,271	2.90	7.43	6,588
May 22	do	215	2,035	2.32	6.85	4,718
June 15	M. S. Brennan	208	1,421	1.78	3.67	2,524
July 13	do	225	2,100	2.50	6.58	5,230
August 13	do	207	1,346	1.83	3.24	2,469

Daily gage height, in feet, of Menominee River near Iron Mountain, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	.....	2.35	7.4	8.6	3.6	5.5	4.2	2.8	2.82	3.3	1.8
2	2.58	.....	2.38	6.8	8.4	5.6	8.6	3.7	3.9	2.8	3.3	1.75
3	.....	.....	2.45	6.7	8.5	2.4	6.4	3.4	7.2	2.5	3.2	2.25
4	.....	.....	.....	7.0	9.1	2.4	7.1	3.5	8.0	2.42	3.0	2.3
5	2.35	.....	.....	7.9	9.2	3.5	8.0	3.4	7.8	2.42	3.0	2.25
6	2.6	2.7	.....	8.0	9.2	6.3	8.0	3.45	7.0	2.35	2.95	2.65
7	2.6	.....	.....	7.45	9.3	6.9	7.6	3.3	6.3	2.4	2.88	3.3
8	2.8	.....	2.6	6.8	9.2	7.3	7.6	3.25	5.3	2.42	2.92	3.15
9	2.82	.....	2.62	6.8	9.8	6.3	5.8	3.4	4.6	2.4	3.0	3.2
10	.....	.....	2.6	6.6	9.6	7.1	4.2	3.3	4.4	2.35	3.0	3.2
11	.....	.....	.....	7.0	9.1	5.2	5.2	3.4	4.1	2.4	3.0	3.3
12	.....	.....	.....	7.3	9.0	5.8	4.9	3.2	3.7	2.45	3.0	3.2
13	.....	2.4	.....	7.4	9.1	5.7	5.4	3.2	3.35	2.5	2.9	3.45
14	.....	.....	.....	7.4	8.3	5.7	5.2	3.3	3.0	2.55	2.98	3.3
15	.....	.....	2.38	6.7	7.4	5.8	5.6	3.3	2.95	2.8	3.1	3.25
16	3.2	.....	2.3	0.4	8.6	6.4	4.3	2.8	3.6	2.9	3.15	3.4
17	.....	.....	2.22	6.1	9.7	7.3	4.4	2.5	4.3	2.82	3.05	3.3
18	2.9	2.55	2.25	6.2	10.1	7.2	6.1	2.65	4.4	2.98	2.9	3.25
19	2.92	.....	2.35	5.8	10.2	10.2	3.9	2.5	4.8	3.1	2.88	3.0
20	2.95	.....	2.5	5.8	9.3	9.3	3.4	2.7	4.9	3.3	2.9	2.95
21	2.78	2.35	2.4	5.7	10.2	6.7	2.2	2.72	4.8	3.5	3.05	2.85
22	2.75	.....	2.45	6.0	7.4	8.4	2.05	2.25	4.4	3.5	3.05	2.7
23	2.5	.....	2.5	6.2	7.4	6.5	2.95	2.0	3.8	3.5	3.1	2.6
24	.....	.....	2.65	6.0	7.4	6.5	3.9	2.22	3.5	3.5	3.05	2.6
25	.....	2.35	2.98	5.8	6.0	5.8	3.7	2.28	3.45	3.55	3.15	2.62
26	.....	2.4	3.4	6.4	5.2	5.6	3.7	2.2	3.15	3.5	3.2	2.65
27	.....	2.4	3.8	6.8	7.6	7.8	3.4	2.28	2.95	3.5	3.05	2.7
28	.....	2.45	4.6	7.6	5.6	7.6	3.95	2.1	3.05	3.4	2.9	2.55
29	3.0	.....	6.0	8.0	4.8	8.0	4.6	2.12	2.85	3.2	2.5	2.4
30	.....	.....	7.6	8.6	5.8	8.9	4.7	2.07	2.8	3.2	1.8	2.4
31	.....	.....	7.4	.....	3.4	.....	4.6	2.0	.....	3.3	.....	2.48

NOTE.—Ice conditions January 1 to March 31. At no time was the river frozen entirely across, there being open water of varying area above and below the gage. Thickness of ice not more than 0.2 foot except along the banks. Gage heights are to water surface.

Station rating table for Menominee River near Iron Mountain, Mich., from September 4, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*
1.20	1,032	2.80	2,080	4.40	3,242	6.80	5,230
1.30	1,094	2.90	2,150	4.50	3,319	7.00	5,420
1.40	1,156	3.00	2,220	4.60	3,396	7.20	5,615
1.50	1,219	3.10	2,290	4.70	3,474	7.40	5,815
1.60	1,282	3.20	2,361	4.80	3,552	7.60	6,025
1.70	1,346	3.30	2,432	4.90	3,630	7.80	6,235
1.80	1,410	3.40	2,503	5.00	3,708	8.00	6,450
1.90	1,475	3.50	2,575	5.20	3,865	8.20	6,670
2.00	1,540	3.60	2,647	5.40	4,023	8.40	6,900
2.10	1,606	3.70	2,719	5.60	4,183	8.60	7,140
2.20	1,672	3.80	2,792	5.80	4,345	8.80	7,380
2.30	1,739	3.90	2,866	6.00	4,510	9.00	7,630
2.40	1,806	4.00	2,940	6.20	4,680	9.20	7,890
2.50	1,874	4.10	3,015	6.40	4,860	9.40	8,150
2.60	1,942	4.20	3,090	6.60	5,040	9.60	8,410
2.70	2,011	4.30	3,166				

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is not well defined. Above gage height 9.60 feet the rating curve is a tangent, the difference being 140 per tenth.

Estimated monthly discharge of Menominee River near Iron Mountain, Mich., for 1905.

[Drainage area 2,415, square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	7,140	4,265	5,282	2.19	2.44
May	9,250	2,503	6,810	2.82	3.25
June	9,250	1,806	5,011	2.07	2.31
July	7,140	1,573	3,850	1.59	1.83
August	3,090	1,540	2,130	.882	1.02
September	6,450	2,080	3,284	1.36	1.52
October	2,611	1,772	2,163	.896	1.03
November	2,432	1,410	2,204	.913	1.02
December	2,539	1,378	2,085	.863	.995

IRON RIVER BASIN.

IRON RIVER NEAR IRON RIVER, MICH.

This station was established September 1, 1903, by the engineers of the Oliver Iron Mining Company. It is located at the mine bridge, 1 mile below a dam used for ponding logs, which at times causes fluctuations.

The bed of the stream is composed of gravel and small bowlders and the current is swift. The stream rarely freezes over at the gaging station. The pumpage from the mine enters the stream a short distance above the gage; September 5, 1902, it amounted to 1.7 second-feet.

Discharge measurements are made from the mine bridge, which has a span of 30 feet between abutments.

The gage is a vertical board attached to a braced cedar post at the left end and upstream side of the bridge. It was read during 1905 by W. J. Phillips, an engineer of the mining

company. All gage heights have been expressed in terms of their elevation above the mine datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 476; 129, p 24.
Discharge: 97, p 476.
Discharge, daily: 97, pp 470–482.
Discharge, monthly: 97, p 483.
Gage heights: 97, p 477; 129, p 24.
Rainfall data: 97, p 483.
Rating table: 97, p 478.

Daily gage height, in feet, of Iron River near Iron River, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	86.3	86.3	86.15	86.9	86.95	17	86.3	86.15	86.2	86.9	.....
2	86.3	86.3	86.15	86.9	86.95	18	86.3	86.15	86.2	86.8	.....
3	86.3	86.3	86.15	86.9	87.1	19	86.3	86.15	86.2	86.8	.....
4	86.3	86.3	86.15	87.85	87.5	20	86.3	86.15	86.15	86.8	.....
5	86.3	86.3	86.2	87.7	87.35	21	86.3	86.15	86.15	86.8	.....
6	86.3	86.3	86.2	87.35	87.2	22	86.3	86.15	86.15	86.8	.....
7	86.3	86.3	86.2	86.9	87.4	23	86.3	86.15	86.15	86.8	.....
8	86.3	86.3	86.2	86.9	87.3	24	86.3	86.15	86.15	86.8	.....
9	86.3	86.3	86.2	87.4	87.3	25	86.3	86.15	86.15	86.75	.....
10	86.3	86.3	86.2	87.1	87.25	26	86.3	86.15	86.5	86.75	.....
11	86.3	86.3	86.2	88.1	87.25	27	86.3	86.15	86.75	86.75	.....
12	86.3	86.15	86.2	87.4	87.2	28	86.3	86.15	86.9	87.0	.....
13	86.3	86.15	86.2	87.1	87.2	29	86.3	.....	87.45	87.0	.....
14	86.3	86.15	86.2	87.1	.....	30	86.3	.....	87.4	87.0	.....
15	86.3	86.15	86.2	86.9	.....	31	86.3	.....	87.65	.....	.....
16	86.3	86.15	86.2	86.9	.....						

WOLF RIVER BASIN.

WOLF RIVER AT NORTHPORT, WIS.

Wolf River rises about 30 miles south of the line between Michigan and Wisconsin, flows southward, and debouches into the head of Lake Poygan. It occupies a wedge-shaped valley, with a long, gradual western slope and a sharper slope on the eastern side. The principal tributaries, which enter from the west side, have considerable fall, the northern ones especially being frequently broken by rocky rapids.

The gaging station was established April 5, 1905. It is located at the highway bridge in Northport, Wis., a small town about 3 miles downstream from New London.

The channel is straight for 300 feet above and 600 feet below the station. Both banks are low, alluvial, and liable to overflow only during extreme high water. The right bank is occupied by farms and buildings; the left is partly wooded. The bed of the stream is composed of gravel and is free from vegetation and permanent. There is but one channel at all stages and it is divided by the center pier of the bridge. The current is moderate at low stages.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The bridge has one turn span, with central pier, and a small pile approach on the left bank. The initial point for soundings is the inner face of the right abutment.

A standard chain gage, which was read during 1905 by George F. Sansom, is bolted to the top of the plate girder of the bridge. The length of the chain from the end of the weight to the end of the chain proper is 23.52 feet. This length was changed to 16.52 feet September 22, 1905, in order that all readings might be confined to the scale in the box. The gage is referred to bench marks as follows: (1) The top of the tubular iron pier at the downstream

right bank; elevation, 15.77 feet. (2) The top of the iron girder just opposite the pulley of the gage box; elevation, 22.34 feet. Elevations are above the datum of the gage.

Discharge measurements of Wolf River at Northport, Wis., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 5	F. W. Hanna	182	2,642	2.64	7.03	[illegible]
May 27	S. K. Clapp	171	2,198	1.80	4.65	[illegible]
June 17	M. S. Brennan	151	2,553	1.97	6.42	[illegible]
July 15	do	176	2,300	1.60	5.06	[illegible]
August 16	do	176	2,053	1.26	3.51	[illegible]
September 22	F. W. Hanna	172	1,978	1.41	3.60	[illegible]

NOTE.—All gage heights refer to new datum established September 22, 1905.

Daily gage height, in feet, of Wolf River at Northport, Wis., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.4	6.0	3.3	2.0	1.6	1.55	1.3	[illegible]
2	.....	3.6	5.0	3.0	2.3	2.4	1.4	1.4	1.6
3	.....	3.8	5.0	3.4	2.2	2.2	1.35	1.5	1.4
4	.....	4.0	4.9	3.6	2.1	2.6	1.3	1.6	[illegible]
5	.....	4.2	4.6	3.8	2.3	3.1	1.15	1.7	[illegible]
6	6.9	4.4	5.6	3.3	2.2	3.4	1.1	1.95	[illegible]
7	6.8	4.6	5.4	4.3	2.4	3.6	.9	2.1	[illegible]
8	6.7	4.8	5.3	4.6	2.9	3.3	.85	2.3	[illegible]
9	6.6	4.8	5.8	4.6	3.3	3.4	.7	2.5	2.1
10	6.5	5.0	5.8	4.9	4.0	3.6	.65	2.7	2.0
11	6.4	5.0	5.8	5.0	3.5	3.8	.6	2.6	1.9
12	6.3	5.2	5.9	5.2	3.6	3.5	.5	2.4	1.95
13	6.1	5.6	6.1	5.1	3.6	2.8	.35	2.3	[illegible]
14	6.0	5.8	6.4	5.1	3.0	2.5	.1	2.2	[illegible]
15	5.8	5.6	6.4	4.9	3.0	2.7	.25	2.1	1.4
16	5.6	5.5	6.6	4.2	3.5	2.9	.4	1.8	1.2
17	5.5	5.3	6.5	4.6	3.5	2.8	.75	1.5	1.2
18	5.2	5.3	6.4	4.3	3.3	3.0	.9	1.4	1.1
19	5.2	5.2	6.4	4.8	3.2	3.4	1.15	1.3	1.0
20	4.9	5.0	6.2	4.6	3.0	.....	1.5	1.2	1.0
21	4.8	4.8	6.0	4.45	2.8	2.9	2.2	1.1	1.0
22	4.8	4.6	5.8	4.2	2.4	2.8	2.6	1.0	1.0
23	4.3	4.6	5.6	4.1	2.5	3.7	2.9	.9	.9
24	4.1	4.8	5.3	4.0	2.3	3.6	3.2	.8	.9
25	4.0	5.0	5.1	3.3	2.0	3.4	3.4	.6	.75
26	3.8	5.0	4.7	3.6	1.8	3.25	3.3	.4	.6
27	3.6	4.6	4.4	2.8	1.6	3.1	3.2	.2	.5
28	3.5	4.3	4.0	2.5	1.4	2.9	3.0	.6	.5
29	3.5	5.4	3.8	2.3	1.2	2.75	2.1	.8	.4
30	3.4	5.6	3.5	2.2	1.1	2.35	2.3	1.9	.4
31	.....	5.8	.....	2.0	1.0	.....	2.0	.....	.....

NOTE.—All gage heights refer to new datum established September 22, 1905.

ST. JOSEPH RIVER BASIN.

DESCRIPTION OF BASIN.

St. Joseph River rises at Bunday Hills, in northern Hillsdale County, Mich., flows southwestward into Indiana, turns northward at South Bend, recrosses the State line near

Bertrand, and debouches into Lake Michigan at St. Joseph. The total area drained is approximately 4,586 square miles, of which 2,916 square miles are in Michigan and 1,670 square miles are in Indiana. The drainage basin contains more than 400 small lakes, varying in surface area from one-eighth of a square mile to 6 square miles. Of these approximately 100 are in Indiana and 300 in Michigan. No storage is developed on the stream.

The drainage basin lies in a completely glaciated region and is overlain with diversified drift deposits. The current of the river from South Bend to its mouth was formerly reversed, and this valley formed an outlet for the waters of Lake Michigan, which turned to the southwest, through Kankakee River, at South Bend, and thus reached the Mississippi through Illinois River.

The basin of the St. Joseph in Michigan contains relatively little marsh land not artificially drained and relatively little uncleared land. About a third of the lakes, however, are without visible outlets. The proportion of undrained lakes in Indiana is smaller and the swamp lands are much more extensive.

Elkhart River, one of the principal Indiana tributaries of the St. Joseph, drains an area of about 500 square miles, which contains large lakes and extended swamps, the principal fall of the stream occurring in its passage from marsh to marsh.

ST. JOSEPH RIVER AND PORTAGE CREEK AT MENDON, MICH.

This station was established October 25, 1902. It is located at the Marantette Bridge, near Mendon, Mich.

The channel is straight for some distance below the bridge, but bends above. It is broken by an old bridge pier in the center, which causes eddying and some dead water. The bridge has a single span of 136.5 feet between abutments, stands squarely across the direction of the current, and affords a fairly permanent cross section for gaging, the bed being of smooth clay. The growth of aquatic plants in the channel changes the relation of gage height to discharge during the summer. Portage Creek enters the St. Joseph between the gage and the measuring section and complicates the problem somewhat. This river flows parallel to and about 1 mile distant from the St. Joseph at Mendon and was at one time diverted across the divide, affording water power with a fall of 20 feet, but this diversion has been discontinued.

Discharge measurements of St. Joseph River are made from Marantette Bridge. The initial point for soundings is the face of the right abutment, downstream side.

The gage, which was read during 1905 by William P. McCoy, is a vertical board attached to a cedar post near the water's edge, about half a mile above the station. The bench mark is the top of the head of a spike driven into the brick wall at the southeast corner of the Masonic Hall building, 150 feet northwest from the gage; elevation above zero of gage, 19.95 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 265-266; 97, p 462; 129, p 26.
Discharge: 83, p 266; 97, p 463; 129, p 26.
Gage heights: 83, p 266; 97, p 463; 129, p 27.
Water powers: 83, p 266.

Discharge measurements of St. Joseph River at Mendon, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 2[a]	H. R. Beebe	130	512	2.13	1.90	1,093
November 7[b]	E. F. Weeks	129	481	1.50	1.53	710
November 9[b]	do	129	500	1.63	1.70	818

[a] Some grass in channel. [b] Not much grass in channel.

A discharge measurement of Portage Creek made November 9, 1905, by E. F. Weeks gave the following results: Area of section, 26 square feet; mean velocity, 1.22 feet per second; gage height (distance to water surface from top of hand rail on downstream side, right end of bridge), 22.75 feet; discharge, 31.6 second-feet.

Daily gage height, in feet, of St. Joseph River at Mendon, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	1.2	1.6	2.6	1.75	1.95	1.5	1.7	1.6	1.5	1.3	1.5
2	1.5	1.2	1.6	2.6	1.7	1.9	1.5	1.7	1.7	1.5	1.3	1.6
3	1.5	1.2	1.55	2.45	1.7	1.95	1.5	1.7	1.8	1.5	1.3	1.7
4	1.5	1.2	1.5	2.4	1.65	1.8	1.5	1.7	1.9	1.5	1.3	1.8
5	1.5	1.2	1.5	2.25	1.9	1.8	1.55	1.7	2.1	1.5	1.3	1.9
6	1.45	1.2	1.45	2.05	2.0	1.8	1.6	1.72	2.0	1.3	1.4	1.8
7	1.45	1.2	1.4	1.9	2.0	1.9	1.7	1.75	2.0	1.3	1.5	1.7
8	1.35	1.2	1.4	1.9	2.0	2.05	1.8	1.75	1.95	1.2	1.6	1.6
9	1.25	1.2	1.4	1.75	2.0	2.2	1.9	1.72	1.9	1.2	1.6	1.5
10	1.2	1.2	1.4	1.7	2.0	2.35	2.05	1.6	1.8	1.2	1.7	1.4
11	1.2	1.2	1.5	1.7	2.75	2.4	2.35	1.6	1.8	1.2	1.7	1.3
12	1.25	1.25	1.3	1.7	3.85	3.35	2.5	1.6	1.7	1.2	1.7	1.2
13	1.3	1.3	1.3	1.7	5.2	2.3	2.7	1.5	1.6	1.2	1.8	1.2
14	1.35	1.3	1.3	1.7	5.85	2.3	2.6	1.5	1.6	1.2	1.7	1.2
15	1.4	1.3	1.45	1.7	5.75	2.3	2.6	1.65	1.5	1.2	1.6	1.2
16	1.4	1.4	1.5	1.6	5.5	2.2	2.5	1.7	1.5	1.2	1.5	1.2
17	1.4	1.4	1.6	1.55	5.0	2.2	2.35	1.8	1.6	1.2	1.4	1.2
18	1.4	1.4	2.1	1.5	4.7	2.35	2.25	1.8	1.8	1.25	1.4	1.2
19	1.4	1.4	2.6	1.5	4.25	2.55	2.0	1.8	1.9	1.4	1.3	1.2
20	1.35	1.4	3.1	1.5	4.7	2.15	2.0	1.8	1.9	1.45	1.2	1.2
21	1.3	1.4	3.55	1.95	3.45	2.0	1.9	1.8	1.9	1.6	1.1	1.1
22	1.3	1.4	3.8	2.25	3.05	1.9	1.8	1.8	1.9	1.6	1.1	1.1
23	1.3	1.4	3.75	2.8	2.7	1.8	1.8	1.9	1.9	1.7	1.1	1.1
24	1.3	1.4	3.65	2.8	2.45	1.8	1.7	1.9	1.9	1.7	1.1	1.1
25	1.3	1.5	3.55	2.8	2.4	1.8	1.7	1.8	1.8	1.7	1.2	1.1
26	1.3	1.5	3.4	2.8	2.4	1.8	1.7	1.8	1.8	1.7	1.3	1.1
27	1.3	1.55	3.15	2.6	2.35	1.8	1.7	1.7	1.7	1.7	1.3	1.2
28	1.3	1.6	2.95	2.5	2.15	1.75	1.7	1.7	1.6	1.6	1.3	1.2
29	1.25	.....	2.75	2.4	2.05	1.6	1.7	1.6	1.5	1.45	1.4	1.2
30	1.2	.....	2.65	1.95	2.0	1.55	1.7	1.6	1.5	1.35	1.5	1.2
31	1.2	.....	2.6	.....	2.0	.....	1.7	1.6	.....	1.3	.....	1.3

NOTE.—Ice conditions January and February.

ST. JOSEPH RIVER NEAR BUCHANAN, MICH.

This station was established April 1, 1901. It is located at the dam of the South Bend Electric Company, 1 mile below the village of Buchanan.

The dam is of frame timber, of the Beardsley type, 10 feet high, and rests on an earth foundation, leakage being prevented by means of triple sheet-piling at the downstream toe. The upstream face of the dam has a slope of approximately 2.4 horizontal to 1 vertical. The downstream side is also faced with a sloping apron, the two slopes meeting at the crest at an angle of 90°. The dam is level and is 392.5 feet long. There was a small amount of leakage through the dam in 1901. Repairs were made in 1903, an estimate of the leakage was obtained, and a new profile was taken.

The crest gage is attached to piling 45 feet upstream from the crest and is read four times each day by Charles E. Babcock.

On the left-hand side of the dam are two 35-inch Leffel turbines, in separate vertical-cylinder cases, connected by a single governor; from them power is transmitted to adjacent mills by manila rope. The average working head on the water wheels is 11.25 feet.

In June, 1904, a new power plant was put into operation at this dam. The new plant contains three units, each containing three wheels. The turbines are 68-inch Leffel-Samson. The first and second units are controlled by Lombard governors; the third unit is controlled by hand. There is also a 40-inch Leffel-Samson turbine used to drive the exciters. A record is kept of the number of hours per day each turbine unit is operated, and governor readings are taken every four hours, showing the proportion and part of full gate opening at which the wheels are being operated. A record of the total electrical output, in kilowatt hours, is also obtained.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 262-263; 129, pp 27-28.
Discharge, daily: 83, pp 263-264; 129, pp 28-29.
Discharge, monthly: 83, p 265; 129, p 30.

Daily discharge, in second-feet, of St. Joseph River near Buchanan, Mich., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,451	5,559	4,782	4,154	2,519	2,025	2,264	1,466	2,681	3,474
2	2,579	5,000	4,221	3,945	2,204	2,163	2,695	2,548	2,925	3,339
3	2,569	5,269	4,001	3,952	1,749	2,172	2,206	2,007	2,562	3,220
4	2,654	5,019	3,558	3,230	2,272	1,933	2,457	2,114	2,735	3,561
5	2,527	5,019	3,731	3,672	2,593	2,095	3,432	1,802	2,113	3,450
6	3,253	4,953	3,857	3,459	2,426	1,788	2,500	1,985	2,970	2,908
7	3,049	4,717	3,587	3,435	2,861	2,928	2,853	2,127	3,005	3,173
8	3,031	4,326	4,164	3,659	2,849	2,310	2,528	1,297	2,896	3,203
9	3,068	3,814	3,986	3,570	2,470	2,205	2,559	1,965	3,326	2,688
10	3,386	4,278	3,941	3,680	3,491	2,206	1,644	1,938	3,257	2,862
11	3,721	3,981	4,343	3,473	4,074	1,641	2,284	1,548	3,196	3,430
12	3,562	3,990	6,810	4,496	4,703	1,760	2,055	1,940	2,776	3,158
13	3,845	3,958	9,352	4,837	4,853	991	1,926	1,833	3,481	3,020
14	3,600	3,989	9,592	4,481	4,463	2,045	1,984	2,200	3,164	2,997
15	3,304	3,736	10,132	4,377	4,013	1,968	1,984	2,059	2,422	2,746
16	3,248	3,432	10,263	4,167	3,387	2,300	1,867	1,604	3,138	2,562
17	3,417	3,950	10,218	3,964	3,945	1,868	1,406	1,570	2,706	2,188
18	4,401	3,575	10,041	3,057	3,369	2,015	1,790	1,981	2,617	2,519
19	5,656	3,560	9,054	3,328	3,060	1,906	2,161	2,078	2,195	2,231
20	7,485	3,550	8,537	3,693	3,126	1,525	1,936	2,586	2,328	2,537
21	7,801	4,086	7,426	3,563	3,035	1,938	1,981	2,731	2,196	2,927
22	7,367	5,940	7,085	3,244	2,963	2,126	2,337	2,392	2,007	3,188
23	7,346	6,098	6,380	3,476	2,180	2,473	2,527	2,948	1,846	3,207
24	7,774	6,249	5,605	3,099	2,957	1,795	1,996	2,972	2,678	3,407
25	8,122	5,865	5,314	2,740	2,826	2,799	2,591	2,801	2,227	3,233
26	7,424	5,662	5,313	2,886	2,414	2,407	2,847	2,757	2,094	2,662
27	7,351	5,662	5,156	2,649	2,386	2,537	2,749	2,779	2,282	2,920
28	6,638	5,412	4,414	2,710	2,525	2,287	2,717	2,808	2,685	3,272
29	5,971	5,352	4,671	2,472	2,802	2,150	2,455	2,464	2,794	3,285
30	5,849	4,639	4,344	2,565	1,849	1,971	2,520	3,087	2,998	3,441
31	5,849	.....	4,616	.....	2,453	1,983	.....	2,516	.....	3,360

NOTE.—Ice conditions January and February.

Estimated monthly discharge of St. Joseph River near Buchanan, Mich., for 1905.

[Drainage area, 3,935 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	8,122	2,451	4,784	1.22	[illegible]
April	6,249	3,432	4,688	1.19	[illegible]
May	10,260	3,558	6,060	1.54	[illegible]
June	4,837	2,472	3,534	.898	[illegible]
July	4,853	1,749	2,994	.760	[illegible]
August	2,928	991	2,075	.527	[illegible]
September	3,432	1,406	2,308	.586	[illegible]
October	3,087	1,297	2,223	.565	[illegible]
November	3,481	1,846	2,617	.665	[illegible]
December	3,561	2,188	3,038	.772	[illegible]

KALAMAZOO RIVER BASIN.

DESCRIPTION OF BASIN.

Kalamazoo River rises in southwestern Jackson County, Mich., flows in a general northwesterly direction, and enters Lake Michigan at Saugatuck. Its length is about 100 miles.

The drainage basin is mostly overlain with deep glacial deposits. There is no important outcrop of rock within the area, although in the vicinity of Ceresco the stream flows over sandstone of the Carboniferous system. Springs issuing from glacial moraines or breaking through the underlying sandstone from the great artesian basin of the State supply the river with a considerable body of water.

The soil of the drainage basin is light, comprising chiefly sand and sandy loam, except in the marshes and river valleys, where it is somewhat impervious.

Owing to its steady regimen the Kalamazoo is of great value for water power. Within the past five years three dams and power plants have been constructed to generate electricity for electric traction. An additional plant for this purpose is now under construction at Ceresco. Water power is also used for general manufacturing purposes at Allegan, Battle Creek, Albion, and other points.

KALAMAZOO RIVER NEAR ALLEGAN, MICH.

This station was established April 4, 1901. It is located at the dam of the Commonwealth Power Company, in Trowbridge Township, 6 miles upstream by the river from Allegan.

The dam is of timber cribwork filled with stone, resting on a pile foundation in clay hardpan. It is equipped with three Taintor segmental flood gates, each of 19.7 feet clear width. The pond above the dam covers an area of 1,000 acres.

In the adjacent power house, forming a portion of the dam, are eight 43-inch Leffel-Samson turbines, arranged in two sets on a horizontal shaft, each set controlled by a separate governor. The turbines run continuously and the flow of the stream is nearly all utilized except in times of extreme freshet, when the water level is controlled by means of the flood gates. The effective head varies from 21 to 23 feet.

The gaging record includes the number of hours of daily run, the average gate opening of the turbines as indicated by the index wheels of the governors, the stage of water on the tailrace gage, and the reading of the crest gage. The crest gage is set with its zero at the elevation of the horizontal spillways, which have a crest width of 20 feet each and which are closed by the Taintor gates. The crest gage also serves to show the depth of water flowing over the crests of the Taintor gates or of flashboards placed on them. A record of the opening

and closing of the Taintor gates is kept. The crest and tailrace gages are set with a difference of elevation of 12 feet, and the bench mark to which both are referred is the top of the masonry pier at the entrance to the flume. The elevation of this bench mark above the zero of the crest gage is 16.05 feet, and above the zero of the tailrace gage, 28.05 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 267-268; 97, pp 457-459; 129, p 32.
Discharge: 97, p 458.
Discharge, daily: 83, pp 269-270; 97, p 459; 129, pp 32-33.
Discharge, flood: 83, pp 268-269.
Discharge, monthly: 83, p 271; 97, p 460; 129, p 33.

Daily discharge, in second-feet, of Kalamazoo River near Allegan, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,506	1,129	1,153	2,403	1,115	1,304	1,076	974	840	716	851	1,066
2	1,229	1,065	979	2,070	1,215	1,268	932	705	1,020	851	851	1,220
3	1,204	861	1,071	1,780	1,254	1,219	981	779	1,161	861	779	1,380
4	1,128	928	1,084	2,358	1,158	1,196	1,261	855	844	928	779	1,226
5	917	925	1,034	2,318	1,158	1,087	1,259	992	984	851	788	1,160
6	928	851	1,198	2,135	1,158	1,592	1,268	1,211	983	917	1,256	1,087
7	1,061	788	1,042	1,734	1,146	2,025	1,390	809	1,161	904	1,351	1,122
8	1,001	928	969	1,674	1,224	2,187	1,061	884	851	713	1,590	1,057
9	1,129	928	1,099	1,597	1,021	2,282	1,809	918	991	705	1,149	993
10	980	914	1,117	1,470	1,470	2,715	1,464	855	786	851	1,464	1,108
11	833	811	1,274	1,645	2,415	3,317	2,167	861	926	904	1,464	1,096
12	707	571	1,308	1,457	4,060	3,275	2,310	928	958	904	1,590	1,082
13	789	716	1,230	1,375	3,220	3,275	2,365	716	928	910	1,337	1,160
14	1,020	1.183	1,050	1,447	3,500	2,470	2,583	861	917	851	1,115	1,145
15	901	859	1,224	1,625	3,360	2,580	1,970	861	840	716	975	1,177
16	1,065	861	1,019	1,509	3,740	2,236	2,054	1,235	914	980	833	1,225
17	925	925	1,486	1,220	3,420	1,718	1,419	1,372	746	928	928	840
18	1,128	855	2,087	1,101	3,150	1,592	1,415	1,245	956	925	992	770
19	992	788	3,494	1,237	2,583	1,515	1,345	1,297	856	989	928	917
20	928	992	3,157	1,099	2,478	2,008	1,322	1,121	946	917	1,192	1,065
21	929	1,232	3,493	1,970	2,428	1,926	1,207	1,110	1,153	989	1,065	1,115
22	882	716	3,470	1,952	1,601	1,896	1,169	885	1,178	1,043	1,052	1,245
23	940	928	4,091	1,954	1,694	1,530	1,465	1,080	1,044	1,770	980	1,289
24	946	861	5,219	1,778	1,601	1,340	1,114	928	1,006	769	788	1,248
25	1,065	788	4,073	1,809	1,583	1,469	1,157	928	861	855	1,065	1,023
26	989	725	3,702	2,034	2,324	990	951	1,001	861	928	716	1,065
27	779	789	3,162	1,949	1,680	1,034	891	788	861	1,092	1,129	1,130
28	789	720	3,152	1,735	1,725	1,142	959	928	858	989	1,031	1,159
29	732	.....	2,860	1,545	1,380	1,020	707	914	716	1,209	1,320	1,322
30	948	.....	2,783	1,484	1,464	984	707	851	990	904	1,420	1,289
31	878	.....	2,533	.....	1,355	.....	779	779	.....	773	.....	1,151

Estimated monthly discharge of Kalamazoo River near Allegan, Mich., for 1905.

[Drainage area, 1,471 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,506	707	976	0.664	0.766
February	1,232	571	880	.598	.622
March	5,219	969	2,149	1.46	1.68
April	2,403	1,099	1,720	1.17	1.30
May	4,060	1,021	2,022	1.37	1.58
June	3,317	984	1,806	1.23	1.37
July	2,583	707	1,392	.945	1.09
August	1,372	705	957	.651	.751
September	1,178	716	938	.638	.712
October	1,770	705	924	.628	.724
November	1,590	716	1,093	.743	.829
December	1,380	770	1,130	.768	.885
The year	5,219	571	1,332	.905	12.31

REED'S SPRINGS NEAR ALBION, MICH.

A gaging station was established December 7 and 8, 1904, for the purpose of obtaining information concerning the permanence of the supply furnished to streams by the numerous springs in the Michigan moraines. A weir was erected on the largest group of such springs that has been observed in lower Michigan. This group is located near the western city limit of Albion, Mich., and the outflow passes into the Kalamazoo River below the junction of the two main branches.

The soil at the springs is coarse gravel and quicksand. Higher ground, including a morainic ridge, lies to the southwest. Within about 500 feet of the springs is a gravel pit, in which water sometimes occurs at an elevation about the same as that of the springs. Ground water in an adjoining well on land 10 to 20 feet above the springs is found at a depth of 14 feet.

The weir has a level crest of 3 feet net length, with two end contractions. The discharge is calculated by the Francis formula from gage readings taken once each week by M. O. Reed.

Gage heights, in feet, and discharge in second-feet, of Reed's Springs near Albion, Mich., for 1904 and 1905.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1904.			1905.		
December 8	1.086	2.64	June 4	1.11	2.85
December 12	1.09	2.66	June 11	1.12	2.94
December 19	1.09	2.66	June 17	1.12	2.94
December 26	1.09	2.66	June 25	1.12	2.94
1905.			July 9	1.10	2.75
January 2	1.10	2.75	July 16	1.12	2.94
January 9	1.10	2.75	July 23	1.11	2.85
January 16	1.10	2.75	July 30	1.10	2.75
January 23	1.10	2.75	August 6	1.10	2.75
January 30	1.10	2.72	August 13	1.10	2.75
February 6	1.10	2.75	August 27	1.10	2.75
February 13	1.10	2.75	September 3	1.09	2.66
February 20	1.10	2.75	September 10	1.09	2.66
February 26	1.10	2.75	September 24	1.09	2.66
March 5	1.10	2.75	October 1	1.09	2.66
March 12	1.10	2.75	October 8	1.08	2.57
March 22	1.11	2.85	October 15	1.08	2.57
March 26	1.11	2.85	October 22	1.08	2.57
April 2	1.11	2.85	October 29	1.08	2.57
April 9	1.11	2.85	November 5	1.08	2.57
April 16	1.11	2.85	November 12	1.085	2.62
April 23	1.11	2.85	November 19	1.08	2.57
April 30	1.11	2.85	November 26	1.08	2.57
May 7	1.11	2.85	December 3	1.08	2.57
May 14	1.13	3.14	December 10	1.09	2.66
May 21	1.12	2.94	December 17	1.08	2.57
May 28	1.12	2.94			

GRAND RIVER BASIN.

DESCRIPTION OF BASIN.

Grand River rises in the southern part of Jackson County, Mich., flows in a general northerly and northwesterly direction, and empties into Lake Michigan at Grand Haven. Its drainage area, which comprises a rich agricultural region in the south-central portion of Michigan, includes extensive swamps and marshes but comparatively few lakes. At Grand Rapids the stream passes over a limestone ledge, making a considerable fall, which has been developed for power purposes, and at Grand Ledge a similar descent occurs over Carboniferous sandstone.

The Grand receives a number of important tributaries, notably Flat, Thornapple, Maple, Lookingglass, and Red Cedar rivers.

Gaging stations are maintained by the United States Geological Survey on the main stream at Grand Rapids and North Lansing, and arrangements have been made for the establishment of a station near the headwaters at Jackson. Observations of stage during floods are taken at a number of points along the river by the United States Weather Bureau.

GRAND RIVER AT JACKSON, MICH.

The gage at Jackson is not yet installed, but a current-meter measurement was made November 11, 1905, by R. E. Horton and E. F. Weeks at the North Street Bridge, at which point the stream flows over a sandstone bed. The water surface was 3.92 feet below the top of the downstream side of the right abutment. The discharge was 122 second-feet.

GRAND RIVER AT NORTH LANSING, MICH.

This station was established March 2, 1901. It is located at the Seymour Street Bridge a short distance below the North Lansing dam.

The channel is nearly straight for 200 feet above and below the station. The bed of the stream is composed of gravel and silt and above the bridge is thickly overgrown with weeds. The bridge makes a slight angle with the normal to the direction of the current. The current becomes sluggish at low stages.

Discharge measurements are made from the two-span bridge to which the gage is attached. Each span has a length of 92 feet. The initial point for soundings is the face of the left abutment, downstream side.

The vertical gage, which is read by Thomas Costigan, is attached to the downstream end of the central pier of the bridge.

About November 8, 1901, a low, submerged dam was constructed a short distance downstream from the gaging station, to supply water to the factory of the Michigan Beet Sugar Company. The diversion at this point is small compared with the flow of the stream. In order to determine the effect of the submerged dam on the gage readings, a second gage was established a little farther downstream and comparative readings were taken. The gage readings made prior to the construction of the dam were corrected from the data thus obtained.

Beginning October 10, 1904, gage readings have been taken three times each day—at 6 a. m., noon, and 6 p. m. The mean gage height for the day has been obtained by adding together twice the morning reading, the noon reading, and twice the afternoon reading, and dividing by 5. The different readings are thus given weight in proportion to the number of hours for which they are assumed to represent the stage of the stream. It was found that by using the three daily readings in this manner the integral discharge could be closely approximated.

Observations of the stage were taken at half-hour intervals during a portion of the low-water season of 1904, in order to determine the diurnal variation in stage and discharge resulting from the draft and storage at the mills and dam just above the gaging station. The half-hourly observations were plotted, and the actual daily discharge was integrated from the diagrams by planimeter. The diurnal variation is a maximum in low water, decreasing in effect as the stage of the stream increases.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 315; 83, p 279; 97, p 448; 129, pp 33-35.
Discharge: 83, p 280; 97, p 449; 129, p 35.
Discharge, daily: 83, pp 281-282; 97, p 451.
Discharge, monthly: 83, p 283; 97, p 452; 129, p 37.
Flood-station data: 129, p 36.
Gage heights: 65, p 315; 83, p 280; 97, p 449 129, p 35.
Rating table: 97, p 450; 129, p 36.

Discharge measurements of Grand River at North Lansing, Mich, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 1	H. R. Beebe	186	559	1.41	3.12	788
November 10	E. F. Weeks	189	724	1.51	3.80	1,093

Daily gage height, in feet, of Grand River at North Lansing, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.92	1.99	1.99	5.24	3.23	2.76	2.77	3.39	2.61	2.38	2.41	3.39
2	2.13	1.98	2.21	5.04	3.34	2.77	2.5	2.97	2.84	2.52	2.53	3.27
3	1.98	2.1	2.06	4.6	2.98	2.6	2.72	2.87	2.64	2.44	2.66	3.21
4	2.1	2.06	2.02	4.47	3.04	2.27	2.6	3.04	2.86	2.42	2.56	3.12
5	2.04	1.56	2.02	4.49	3.28	2.64	3.05	3.0	2.72	2.46	2.28	3.02
6	2.05	2.2	2.24	4.19	3.04	10.22	3.0	3.02	2.74	2.33	3.04	3.02
7	1.87	2.14	1.97	4.1	3.58	13.39	3.08	2.83	2.7	2.17	3.57	3.09
8	1.94	2.36	2.12	3.85	3.25	12.85	3.11	2.88	2.66	1.86	3.56	3.16
9	2.38	2.08	2.28	3.74	3.53	12.08	2.83	2.84	2.66	2.16	3.57	3.17
10	2.12	2.25	2.32	3.55	3.34	10.44	3.28	2.57	1.98	2.12	3.63	3.48
11	2.24	2.06	2.42	3.77	4.08	8.72	3.89	2.55	2.54	2.22	3.31	3.64
12	2.11	2.04	2.57	3.91	5.44	7.7	4.04	2.45	2.67	2.29	3.16	3.07
13	1.86	2.16	2.72	3.82	6.42	7.28	3.8	2.66	2.43	2.13	3.5	3.05
14	2.01	2.22	2.44	3.57	7.12	6.07	3.89	2.64	1.92	2.1	3.3	2.74
15	2.06	2.14	2.52	3.48	6.34	5.61	3.61	2.8	2.31	2.06	3.3	2.62
16	2.24	2.08	2.5	3.09	5.66	5.16	3.42	2.92	2.4	2.2	3.16	2.34
17	2.11	1.88	2.86	3.18	5.3	4.62	3.16	2.88	2.76	2.14	3.02	2.16
18	2.16	2.3	5.41	3.17	5.66	4.21	3.1	2.82	4.12	2.36	2.88	2.88
19	2.14	1.79	7.14	2.93	5.43	4.18	3.11	2.65	5.1	2.11	2.46	2.8
20	1.93	2.32	7.63	2.96	4.96	3.8	2.94	2.94	5.08	3.0	3.0	2.52
21	2.05	2.38	7.82	3.99	4.22	3.82	2.72	3.27	4.34	3.37	2.83	2.71
22	1.73	2.42	7.28	5.54	4.06	3.72	2.67	3.21	4.2	2.16	2.8	2.91
23	2.02	2.16	7.0	5.46	3.75	3.72	2.4	2.92	3.7	3.02	2.68	3.04
24	2.16	1.96	6.59	5.03	3.74	3.3	2.46	2.76	2.86	3.08	2.55	2.65
25	2.66	1.85	6.8	4.63	3.57	3.21	2.65	2.5	3.29	2.7	2.46	2.58
26	2.3	2.14	6.59	4.24	3.8	3.38	2.58	2.69	3.08	2.77	2.26	2.82
27	1.97	2.36	5.93	4.14	3.8	3.14	2.49	2.3	2.63	2.72	2.75	2.77
28	2.0	2.18	5.57	3.9	3.24	2.86	2.28	2.62	2.72	2.46	2.93	2.82
29	2.12	.....	4.78	3.52	3.29	2.86	2.9	2.54	2.51	2.35	3.32	2.99
30	2.18	.....	5.28	3.53	3.4	2.8	3.68	2.7	2.32	2.7	3.3	3.61
31	1.92	.....	5.43	.....	2.92	.....	3.18	2.6	.....	2.5	.....	.....

NOTE.—River partly frozen January 1 to April 1.

Station rating table for Grand River at North Lansing, Mich., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	167	3.30	854	5.10	1,820	6.90	3,170
1.60	194	3.40	902	5.20	1,880	7.00	3,260
1.70	222	3.50	950	5.30	1,940	7.20	3,445
1.80	251	3.60	999	5.40	2,000	7.40	3,635
1.90	281	3.70	1,049	5.50	2,065	7.60	3,830
2.00	313	3.80	1,099	5.60	2,130	7.80	4,030
2.10	347	3.90	1,149	5.70	2,195	8.00	4,240
2.20	383	4.00	1,200	5.80	2,265	8.20	4,455
2.30	421	4.10	1,255	5.90	2,335	8.40	4,675
2.40	461	4.20	1,310	6.00	2,405	8.60	4,900
2.50	502	4.30	1,365	6.10	2,485	8.80	5,130
2.60	544	4.40	1,420	6.20	2,565	9.00	5,370
2.70	586	4.50	1,475	6.30	2,645	9.20	5,610
2.80	629	4.60	1,530	6.40	2,730	9.40	5,870
2.90	672	4.70	1,585	6.50	2,815	9.60	6,130
3.00	716	4.80	1,640	6.60	2,900	9.80	6,400
3.10	761	4.90	1,700	6.70	2,990	10.00	6,680
3.20	807	5.00	1,760	6.80	3,080		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902-1905. It is well defined between gage heights 1 foot and 5.4 feet, and fairly well defined above 5.4 feet.

Estimated monthly discharge of Grand River at North Lansing, Mich., for 1905.

[Drainage area, 1,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	569	231	343	0.279	0.322
February	469	183	355	.289	.301
March	4,051	303	1,493	1.21	1.40
April	2,091	685	1,240	1.01	1.13
May	3,369	681	1,342	1.09	1.26
June	12,630	410	2,801	2.28	2.54
July	1,222	413	738	.600	.692
August	897	421	631	.513	.591
September	1,820	287	732	.595	.664
October	888	269	479	.389	.448
November	1,014	406	705	.573	.639
December	1,019	369	711	.578	.666
The year	12,630	183	964	.784	10.65

NOTE.—Estimates not corrected for ice conditions during January, February, and March. Discharge estimated December 31.

GRAND RIVER AT GRAND RAPIDS, MICH.

This station was established March 12, 1901, by L. W. Anderson, city engineer of Grand Rapids. It is located at the Fulton Street Bridge.

The channel is straight for several hundred feet above and below the station and is broken by three bridge piers. The gaging section is shallow, and the bed is composed of cobblestones and gravel, underlain by limestone. The current is rapid and the velocity is poorly distributed at low stages.

Discharge measurements are made from the four-span bridge at which the gage is located. The initial point for soundings is the face of the left abutment, downstream side.

The gage, which was read during 1905 by Henry A. Hopie, is attached to the upstream end of the ice breaker of the left bridge pier. The elevation of its zero is 0.55 foot below the city datum. All gage heights have been expressed as elevations above the city datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 315-316; 83, p 272; 97, p 442; 129, pp 37-38.
Discharge: 49, pp 242, 245; 83, p 272; 129, p 38.
Discharge, daily: 83, pp 275-276; 97, p 446;
Discharge, monthly: 75, pp 111-112; 83, p 277; 97, p 447; 129, p 40.
Flood-station data: 129, p 36.
Gage heights: 49, pp 242, 243-244; 65, pp 316-317; 83, pp 273-274; 97, p 443; 129, pp 38-39.
Rating table: 97, pp 444-446; 129, p 39.
Water powers: 49, pp 247-249.

Discharge measurements of Grand River at Grand Rapids, Mich., in 1905.

Date.	Hydrographer.	Gage height.[a]	Discharge.
		Feet.	*Sec.-ft.*
March 19	Davis and Hoxie	7.33	12,380
March 20	Davis and Roben	7.40	9,686
March 21	do	8.20	12,760
March 22	do	8.52	13,890
March 23	do	8.85	14,720
March 24	do	10.05	17,510
March 25	do	11.30	20,760
March 27	do	12.20	23,360
March 28	do	11.60	21,270
March 29	do	10.53	18,150
March 30	do	9.65	16,040
March 31	do	8.73	13,700
April 1	do	7.83	11,910
April 4	do	6.10	8,924
April 8	do	4.60	7,139
April 11	do	3.15	5,448
June 7	Davis and Luther	13.83	29,490
June 7	do	14.60	34,900
June 8	do	18.10	47,610
June 9	do	18.45	49,300

[a] Elevation above city datum.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.88	0.75	7.85	1.9	3.15	1.18	1.75	0.3	0.5	0.8	2.05
2	.....	.9	.78	.....	1.95	2.75	.....	1.45	.65	.5	.85	1.9
3	1.12	.95	.82	6.55	1.68	2.3	1.12	1.1	.....	.4	.75	.....
4	1.1	.9	.7	6.12	1.62	.....	.....	2.2	.....	.35	.7	1.7
5	.95	.....	.....	5.75	1.5	2.65	1.65	2.55	1.85	.3	.....	1.35
6	.75	1.05	.7	5.4	1.3	10.6	1.9	.....	1.75	.2	1.62	1.5
7	.65	1.1	.65	5.1	.....	14.2	2.2	1.85	1.35	.....	1.98	1.7
8	.....	1.3	.65	4.62	2.05	18.12	2.75	1.35	1.1	.05	2.15	1.35
9	.65	1.3	.68	.....	1.85	18.42	.....	1.2	.8	.15	2.4	1.3
10	1.22	1.25	.7	3.45	2.2	17.7	2.6	1.0	.....	.15	2.35	.....
11	1.55	1.25	.8	3.2	2.75	16.45	2.8	.8	.5	.2	2.15	1.35
12	1.6	.....	.....	2.95	3.82	15.25	3.02	.6	.35	.2	.....	1.5
13	1.5	1.2	.95	2.8	4.58	13.8	3.45	.....	.3	.2	1.6	1.15
14	1.15	1.25	.95	2.6	.....	12.52	3.62	.4	.35	.2	1.78	1.1
15	.....	1.3	.95	2.38	6.55	11.15	3.35	.85	.35	.....	1.6	.65
16	1.15	1.4	.95	.....	6.82	9.85	.....	1.3	.35	.05	1.52	.45
17	1.15	1.15	.95	1.85	6.8	8.7	2.5	1.5	.....	.2	1.4	.....
18	1.05	1.3	4.05	1.65	6.55	.....	2.1	1.45	1.65	2.45	1.35	.55
19	.9	.....	7.2	1.4	6.05	6.2	1.85	2.2	1.85	3.25	.....	.8
20	.8	1.2	8.2	1.4	5.9	5.0	1.58	.....	2.15	3.18	1.08	.8
21	.62	.95	8.22	1.7	.....	4.05	1.3	3.05	2.45	2.8	1.0	1.05
22	.....	.....	8.52	2.65	4.45	3.45	1.08	2.62	2.35	.....	.8	1.05
23	.45	.9	8.85	.....	3.8	3.0	.....	2.2	1.95	2.4	.92	1.22
24	.45	.8	10.2	3.68	3.25	2.62	.75	1.65	.....	2.1	.98	.....
25	.6	.8	11.35	3.52	2.78	.....	.6	1.15	1.3	1.9	1.05	.....
26	.6	.65	12.15	3.32	2.95	2.35	.35	.95	1.0	1.7	.....	.75
27	.7	.7	12.2	2.92	4.02	1.98	.25	.....	.85	1.38	.75	1.15
28	.7	.75	11.52	2.7	.....	1.8	.35	.6	.75	1.3	1.3	1.38
29	.....	.....	10.42	2.55	4.42	1.45	1.55	.55	.65	.....	1.85	1.85
30	.95	.....	9.58	.....	3.5	1.25	.....	.45	.55	.88	.....	2.1
31	.75	.....	8.65	.....	3.5	.....	2.25	.3	.....	.88	.....	.....

NOTE.—No ice at this station during 1905.

Station rating table for Grand River at Grand Rapids, Mich., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	1,700	1.90	3,750	3.80	5,960	7.40	11,230
0.10	1,806	2.00	3,860	3.90	6,080	7.60	11,610
0.20	1,912	2.10	3,970	4.00	6,200	7.80	12,000
0.30	2,018	2.20	4,080	4.20	6,460	8.00	12,400
0.40	2,125	2.30	4,195	4.40	6,720	8.20	12,820
0.50	2,232	2.40	4,310	4.60	6,980	8.40	13,260
0.60	2,339	2.50	4,425	4.80	7,240	8.60	13,700
0.70	2,446	2.60	4,540	5.00	7,500	8.80	14,160
0.80	2,554	2.70	4,655	5.20	7,760	9.00	14,640
0.90	2,662	2.80	4,770	5.40	8,040	9.50	15,870
1.00	2,770	2.90	4,885	5.60	8,320	10.00	17,160
1.10	2,878	3.00	5,000	5.80	8,600	11.00	20,000
1.20	2,986	3.10	5,120	6.00	8,900	12.00	23,100
1.30	3,095	3.20	5,240	6.20	9,200	13.00	26,560
1.40	3,204	3.30	5,360	6.40	9,520	14.00	30,340
1.50	3,313	3.40	5,480	6.60	9,840	15.00	34,400
1.60	3,422	3.50	5,600	6.80	10,160	16.00	38,600
1.70	3,531	3.60	5,720	7.00	10,500	17.00	43,000
1.80	3,640	3.70	5,840	7.20	10,860	18.00	47,450

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901-1905. It is well defined between gage heights 8 feet and 14 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Grand River at Grand Rapids, Mich., for 1905.

[Drainage area, 4,900 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	3,422	2,178	2,696	0.550	0.634
February	3,204	2,392	2,832	.578	.602
March	23,760	2,392	8,706	1.78	2.05
April	12,100	3,204	5,819	1.19	1.33
May	10,190	3,095	5,996	1.22	1.41
June	49,340	3,040	15,670	3.20	3.57
July	5,744	1,965	3,707	.757	.873
August	5,060	2,018	3,204	.654	.754
September	4,368	2,018	2,892	.590	.658
October	5,300	1,753	2,813	.574	.662
November	4,310	2,446	3,201	.653	.729
December	3,970	2,178	3,067	.626	.722
The year	49,340	1,753	5,050	1.03	13.99

NOTE.—Discharge interpolated on days when gage was not read.

MUSKEGON RIVER BASIN.

DESCRIPTION OF BASIN.

Muskegon River drains an area 2,663 square miles in extent, lying directly north of the Grand River basin. Its headwaters rise in the north-central part of the southern peninsula of Michigan, whence it flows in a general southwesterly direction until it enters Lake Michigan near the city of Muskegon. Originally its basin was covered with pine timber, but it is now almost entirely cleared and large stump-covered areas form a conspicuous feature of the topography.

From the vicinity of Evart to Newaygo the Muskegon flows between high banks and has a rapid fall. Levels run for the purpose show that within a distance of 10 miles—5 miles each way from Big Rapids—there is a total fall of 104 feet, practically all of which could be economically developed, as there are favorable sites for the location of dams. Sixteen feet of this fall are now utilized, and a new dam, which, it is stated, will develop 34 feet, is now under construction. It is intended to transmit the electric power to Grand Rapids and Muskegon.

In connection with power development good opportunities exist for the conservation of flow by artificial storage. The water surface areas of the principal lakes of the watershed and of the tributary drainage which they control is given below:

Drainage and surface areas of lakes in Muskegon River watershed.

Lake.	Drainage area.	Water surface
	Sq. miles.	*Sq. miles.*
Muskrat Lake and group	57	[illegible]
Clam Lakes	67	[illegible]
Higgins Lake	67	15.[illegible]
Houghton Lake	185	31.[illegible]
Higgins and Houghton lakes	252	[illegible]

In the upper portion of the watershed there is a total lake area of about 110 square miles. Formerly a lumberman's dam was maintained for the purpose of flooding logs between Higgins and Houghton lakes, but this has been washed out. A lumberman's dam, built of logs and earth, which still remains about 1 mile below the foot of Houghton Lake, raises the water level in that lake 4 feet, providing a storage of 3,350,000,000 cubic feet, in round numbers.

MUSKEGON RIVER AT NEWAYGO, MICH.

This station was established in March, 1901. It is located at the dam of the Newaygo Portland Cement Company, which crosses the Muskegon in a deep valley above the village of Newaygo.

The dam is of timber, having framed cribs filled with stone. It is provided with a main spillway, with log ways, and with four flood ways. The flood ways are fitted with Taintor segmental flood gates, which are operated by a traveling crab. A record is kept of the time and amount of opening of the flood gates and log ways, as well as of the depth of water on the crests of the spillways. Ordinarily the log ways and flood gates are closed and the entire flow passes over the main spillway or through the turbines. Water is carried from the pond to the power house by a short headrace, separated from the stream channel by a crib breakwater.

The power house contained originally two turbine units, but the number has recently been increased to four units. Each unit comprises four 35-inch Leffel-Samson turbine runners mounted on a horizontal shaft, and connected to the electric generator by endless rope drives. Each unit is controlled by a Lombard governor, and beginning with August, 1904, hourly readings of the governors have been taken.

The gaging record includes a statement of the number of hours a day each unit is operated, together with the average gate openings. The wheels are ordinarily operated continuously, twenty-four hours each day.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 49, pp 249-250; 83, p 285; 97, p 442; 129, pp 41-42.
Discharge, mean daily: 129, pp 43-45.
Discharge, monthly: 129, pp 45-46.

Daily discharge, in second-feet, of Muskegon River at Newaygo, Mich., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2,171	1,525	1,697	1,106	1,231	1,080	966	1,256	1,516
2	.....	2,173	1,546	1,634	1,075	1,052	1,200	1,095	1,229	1,516
3	.....	2,269	1,563	1,578	1,182	1,041	1,565	1,048	1,234	1,357
4	.....	2,207	1,648	1,504	1,226	1,162	1,410	1,039	1,293	1,411
5	.....	2,533	1,765	3,120	1,594	1,271	1,373	941	1,047	1,117
6	.....	2,669	1,728	6,885	1,458	1,131	1,104	961	1,243	1,284
7	.....	2,485	2,519	7,121	1,431	1,122	1,066	998	1,466	1,316
8	3,461	2,466	2,616	5,438	1,439	1,066	968	998	1,410	1,260
9	3,454	2,472	2,382	3,713	1,458	988	950	988	1,319	1,363
10	3,412	2,631	2,404	2,966	1,319	977	1,015	1,041	1,489	1,462
11	3,450	2,669	2,843	2,407	1,224	1,080	1,050	1,154	1,223	1,400
12	3,443	2,615	3,069	2,354	1,439	968	1,000	1,130	1,228	1,402
13	3,508	2,557	2,248	2,156	1,258	1,100	1,093	943	1,295	1,389
14	3,508	2,383	2,505	2,003	1,214	1,006	1,136	1,066	1,439	1,166
15	2,188	2,446	2,462	1,896	1,224	1,022	1,146	1,091	1,480	1,105
16	2,150	2,301	2,366	1,961	1,309	909	1,286	994	1,256	1,128
17	2,113	1,963	2,533	1,422	1,193	936	1,326	1,326	983	1,341
18	3,038	1,955	2,126	1,347	1,415	999	1,420	1,400	1,020	1,156
19	3,373	2,019	2,231	1,309	1,308	1,026	1,293	1,626	1,094	1,238
20	3,310	1,876	2,029	1,255	1,309	1,240	1,214	1,262	1,131	1,162
21	3,029	1,979	1,933	1,422	1,373	1,246	1,190	1,522	1,287	1,228
22	3,061	1,843	1,933	1,356	1,194	1,078	1,138	1,278	1,239	941
23	1,796	1,813	2,058	1,290	1,066	1,217	1,037	1,174	1,191	1,480
24	2,972	1,876	2,142	3,352	1,199	1,022	1,089	1,152	1,256	1,319
25	2,658	1,864	2,059	1,255	1,125	1,102	1,025	1,125	1,389	1,063
26	2,359	1,589	2,125	1,388	1,111	1,057	1,013	1,208	1,357	700
27	2,237	1,580	1,966	1,222	1,090	1,229	967	1,238	1,000	712
28	2,350	1,482	1,334	1,214	1,089	1,229	860	1,273	1,427	588
29	2,426	1,493	1,356	1,170	1,258	1,164	869	1,112	1,617	647
30	2,110	1,504	1,854	1,146	1,378	1,122	977	1,305	1,085	612
31	2,094	.....	1,941	.....	1,114	1,073	.....	1,246	.....	615

NOTE.—Ice conditions January 1 to March 8.

Estimated monthly discharge of Muskegon River at Newaygo, Mich., for 1905.

[Drainage area, 2,352 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 8-31	3,508	1,796	2,812	1.20	1.07
April	2,669	1,482	2,129	.905	1.01
May	3,069	1,334	2,091	.889	1.02
June	7,121	1,146	2,286	.972	1.08
July	1,594	1,066	1,264	.537	.619
August	1,271	909	1,092	.464	.535
September	1,565	860	1,129	.480	.536
October	1,626	941	1,154	.490	.565
November	1,617	983	1,266	.538	.600
December	1,516	588	1,161	.493	.568

MANISTEE RIVER BASIN.

MANISTEE RIVER NEAR SHERMAN, MICH.

Manistee River is the northernmost of the group of three large rivers draining the western part of the southern peninsula of Michigan. It has its source in southeastern Antrim County, flows in a general southwesterly direction, and enters Lake Michigan at the city of Manistee, an important lumber center. The harbor at the mouth of the river is excellent. The soil of the drainage basin is sandy, and the stream receives a large portion of its supply from springs along the banks of the main river and tributaries. The fall is gradual and no important utilization of the water power has been made, the principal use of the stream being for rafting logs.

The gaging station was established July 10, 1903. It is located at North Bridge, near Sherman.

The bed of the stream is of clay and sand and has some logs in it, as is the case with many rivers used for lumbering. The river becomes frozen over in the winter to a small extent, so that the relation between gage height and discharge may be modified for that season.

Discharge measurements are made from the single-span bridge at which the gage is located. The initial point for soundings is the left end of the bridge on the downstream side.

A standard chain gage, which was read twice each day during 1905 by Allen Wightman, is fastened to the bridge. The length of the chain is 17.27 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 440-441; 129, pp 46-47.
Discharge: 97, p 441; 129, p 47.
Gage heights: 97, p 441; 129, pp 47-48.

Discharge measurements of Manistee River near Sherman, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 4	H. R. Beebe	67	441	2.56	2.65	1,130
November 8	E. F. Weeks	67	456	2.70	2.70	1,233

Daily gage height, in feet, of Manistee River, near Sherman, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25	3.65	2.15	6.3	3.2	2.8	2.2	2.45	2.1	2.02	2.3	2.52
2	2.4	2.95	2.05	5.95	3.2	2.8	2.1	2.3	2.2	2.0	2.28	2.48
3	2.05	2.95	2.05	5.55	3.3	2.7	2.1	2.2	2.5	2.02	2.25	2.5
4	1.9	2.95	2.05	5.2	3.3	2.6	2.45	2.2	2.5	2.0	2.5	2.48
5	1.95	2.85	2.1	4.85	3.3	2.75	2.5	2.2	2.55	2.0	2.58	2.42
6	2.05	2.85	2.05	4.7	3.35	3.05	2.7	2.3	2.55	2.0	2.52	2.4
7	2.1	2.85	2.05	4.55	3.3	3.2	2.7	2.3	2.45	2.0	2.58	2.4
8	2.0	2.65	2.05	4.3	3.3	3.2	2.9	2.15	2.35	1.95	2.6	2.4
9	1.9	2.75	2.0	4.05	3.35	3.2	2.7	2.2	2.25	1.95	2.72	2.42
10	1.8	2.7	2.0	3.9	3.3	3.2	2.55	2.2	2.15	1.98	2.78	2.4
11	1.65	2.7	2.0	3.75	3.3	3.05	2.5	2.2	2.1	2.05	2.78	2.4
12	1.7	2.7	1.95	3.6	3.3	2.95	2.5	2.1	2.1	2.15	2.72	2.4
13	1.85	2.7	1.7	3.5	3.3	2.85	2.6	2.1	2.1	2.18	2.7	2.4
14	1.95	2.6	1.95	3.5	3.2	2.8	2.55	2.1	2.1	2.15	2.55	2.32
15	2.0	2.6	1.95	3.4	3.15	2.7	2.5	2.15	2.1	2.1	2.48	2.28
16	2.0	2.55	2.1	3.25	3.1	2.6	2.5	2.2	2.1	2.1	2.45	2.22
17	2.0	2.7	2.15	3.1	3.45	2.6	2.9	2.2	2.25	2.18	2.45	2.2
18	2.2	2.7	2.55	3.1	3.45	2.5	3.2	2.2	2.35	2.32	2.42	2.2
19	2.35	2.6	3.1	3.05	3.35	2.5	3.2	2.3	2.35	2.38	2.35	2.28
20	2.35	2.6	3.05	3.0	3.1	2.4	3.25	2.4	2.3	2.5	2.38	2.3
21	2.4	2.5	2.95	2.9	3.0	2.4	3.15	2.45	2.2	2.58	2.4	2.28
22	2.25	2.4	2.95	2.9	3.0	2.4	3.05	2.4	2.2	2.65	2.35	2.3
23	2.2	2.2	3.3	2.95	2.9	2.4	2.9	2.25	2.1	2.65	2.35	2.3
24	2.15	2.25	4.15	2.9	2.8	2.4	2.9	2.2	2.08	2.6	2.35	2.28
25	2.1	2.25	4.6	2.9	2.9	2.3	2.75	2.15	2.0	2.5	2.42	2.22
26	1.9	2.2	4.95	2.9	2.8	2.3	2.55	2.1	2.0	2.45	2.48	2.22
27	1.95	2.25	5.15	2.9	2.8	2.3	2.3	2.1	2.0	2.35	2.6	2.25
28	3.4	2.3	5.35	2.9	2.8	2.3	2.3	2.0	2.0	2.3	2.6	2.25
29	5.05	.....	5.65	2.95	2.8	2.2	2.3	2.0	2.0	2.3	2.7	2.32
30	4.4	.....	6.0	3.2	2.85	2.2	2.3	2.0	2.0	2.3	2.65	2.42
31	4.0	.....	6.35	.....	2.85	.....	2.5	2.1	.....	2.3	.....	2.42

NOTE.—River frozen entirely across, except for air holes, January 25 to February 22. Gage heights are to the water surface in a hole in the ice. The following comparative readings were made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 4	2.9	3.0	0.7
February 11	2.7	2.8	.8
February 18	2.7	2.8	.6

LAKE HURON DRAINAGE.

GENERAL FEATURES.

The area tributary to Lake Huron in the United States comprises the eastern part of the southern peninsula of Michigan. South of Saginaw Bay the Lake Huron slope is very narrow and the brooks and runnels by which it is drained are only a few miles in length. The so-called Thumb of the Mitten is drained chiefly by three short, northward-flowing streams known as Willow, Pinnepog, and Pigeon rivers, which lie in a flat, marshy region. The Saginaw River system is tributary to the bay at its head, while northward from the bay are Rifle, Au Sable, and Thunder Bay rivers, streams having considerable fall, excel-

lent ground storage, and well-sustained flow. Cheboygan River also belongs in the Lake Huron drainage.

The country drained by these rivers is fairly level, rising toward the north. In only a few instances have the streams reached rock, their beds being worn in the drift. None of them are navigable except for short distances, and, so far as shipping is concerned, they are used only for harbors. The rainfall on the Huron slope of the State is less than that on the Michigan slope.

The following pages give the results of data collected during 1905 in the Lake Huron drainage basin.

THUNDER BAY RIVER BASIN.

THUNDER BAY RIVER NEAR ALPENA, MICH.

Thunder Bay River rises in southern Montmorency County, in the northern part of the lower peninsula of Michigan, flows in a general northeasterly direction, and enters Lake Huron at Alpena. The region is largely underlain by fissured limestone, over which is more or less sand, and is covered with dwarfed timber, the original pine forest having been largely cut off. Numerous small lakes occur about the headwaters, and the basin also contains Hubbard Lake, which has a water surface of 13.4 square miles. The regimen of the stream is comparatively steady, but it is more or less influenced by the operation of lumbermen's dams.

The gaging station was established April 4, 1901. It is located at the dam of the Fletcher Paper Company, 4 miles above Alpena.

The dam is of timber, practically water-tight, and is usually surmounted by flashboards. It contains three spillway sections of 90, 105, and 181.5 feet, respectively, and a log slide 40 feet wide. There is also a subsidiary log way and a headrace overflow, the latter 3 feet wide. The crest of the dam was originally level, but settlement of the middle section has made it necessary to subdivide the spillways into several short sections, each being assumed to be level at its average elevation, for purposes of computation.

The adjoining pulp and paper mill has 14 pairs of 26-inch Trump model turbines, arranged in three groups, each containing four turbines on horizontal shafts, with one double horizontal turbine.

The discharge over the main dam has been computed by the weir formula, using coefficients derived from Cornell University experiment No. 13, of the United States Deep Waterways Board, for a dam of similar cross section. Discharge over the flashboard sections has been calculated by means of the Francis formula, and suitable formulas have been used for computation of the flow through the subsidiary log way and headrace overflow.

The record includes two readings each day of the depth on the crest gage, located 75 feet upstream from the head gates, opposite the left end of the dam. The daily run of the turbines and the working head on the wheels, which is determined from readings of the crest and tailrace gage, is also recorded.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 289-290; 97, pp 436-437; 129, p 50.
Discharge: 83, p 290.
Discharge, daily: 83, pp 291-292; 97, p 437; 129 p 51.
Discharge, low-water: 83, p 296.
Discharge, monthly: 82, p 293; 97, p 438; 129, p 51.
Rainfall data: 97, p 438.

Daily discharge, in second-feet, of Thunder Bay River near Alpena, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	702	472	449	5,862	1,084	686	391	597	399	12	546	451
2	612	472	461	5,343	1,187	574	11	520	490	462	546	536
3	510	472	454	4,591	1,462	313	482	539	131	422	533	419
4	1,008	453	428	3,678	1,718	336	244	493	445	401	565	651
5	472	363	579	3,360	1,753	700	569	454	434	408	431	673
6	472	446	472	3,220	1,919	690	534	153	477	397	722	695
7	453	472	462	2,478	1,972	901	614	471	480	379	760	686
8	468	464	468	2,954	1,982	1,117	908	430	456	78	782	698
9	761	455	472	1,749	1,860	1,664	127	414	460	449	976	651
10	761	454	472	1,582	1,591	1,706	528	413	61	425	846	408
11	468	443	473	2,082	1,470	1,471	787	486	494	377	804	692
12	429	271	392	1,535	1,497	1,153	711	521	378	381	509	692
13	460	435	485	1,806	1,243	1,301	649	153	400	394	770	489
14	440	438	472	1,335	512	988	681	579	364	397	644	629
15	277	429	469	1,829	1,221	928	582	567	376	154	664	581
16	459	421	468	470	1,141	922	104	522	386	452	644	476
17	457	433	472	1,279	1,158	927	530	550	64	388	588	326
18	459	410	521	1,281	1,230	285	616	566	439	408	636	511
19	455	299	467	1,067	1,426	1,098	575	588	435	481	457	576
20	464	442	675	1,135	1,542	1,571	575	775	447	425	613	601
21	453	444	700	1,076	769	1,583	656	619	407	458	589	557
22	281	439	700	944	1,314	1,371	585	651	478	155	589	489
23	472	444	755	78	1,084	1,228	147	618	446	959	559	547
24	467	452	780	1,026	1,109	841	574	594	62	952	589	484
25	464	448	1,492	976	931	21	592	492	452	597	670	484
26	446	415	2,354	956	1,057	834	521	411	342	618	461	607
27	442	429	3,007	959	995	660	493	153	323	484	727	626
28	453	448	3,542	936	12	517	384	431	327	519	696	673
29	414	.....	4,319	915	1,190	509	397	475	317	10	631	717
30	444	.....	5,717	816	884	251	150	302	349	912	450	698
31	482	.....	6,326	.....	802	.....	544	300	.....	691	.....	10

Estimated monthly discharge of Thunder Bay River near Alpena, Mich., for 1905.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,008	277	497	0.395	0.455
February	472	271	431	.342	.356
March	6,326	392	1,268	1.01	1.16
April	5,862	78	1,911	1.52	1.70
May	1,982	12	1,262	1.00	1.15
June	1,706	21	905	.718	.451
July	908	11	492	.391	.801
August	775	153	479	.380	.438
September	494	61	371	.294	.328
October	959	10	440	.349	.402
November	976	431	633	.503	.561
December	717	10	559	.444	.512
The year	6,326	10	771	.612	8.31

AU SABLE RIVER BASIN.

AU SABLE RIVER AT BAMFIELD, MICH.

Au Sable River rises in southern Otsego County and follows a tortuous course in a general southeasterly direction to its outlet in Lake Huron at Oscoda, Mich. Its drainage basin, 1,932 square miles in extent, embraces a region at one time noted for the abundance of white pine, but the area is now almost entirely cleared of its valuable native timber and comprises a large extent of sandy plains covered with scrub conifers. Numerous small lakes, wet sand areas, and undrained hollows occur, the topographic features being mainly the work of the retreating ice of the Glacial epoch. The basin is underlain by "Coldwater" shales, but rock outcrops are very rare, the stream bed being usually clay or sand. The tributaries are unimportant, nearly all the rainfall being absorbed by the porous sand areas.

At Bamfield, about 40 miles from the outlet, following the river, the elevation is about 850 feet above sea level, and from this point to the mouth of the stream excellent sites for water power development occur. The stream bed is of firm clay and the river is flanked in many places by high terraced clay bluffs, rising 60 to 100 feet above the stream. In some places the upper half or two-thirds of the bluff is sand, the lower portion being clay, and at the clay horizons numerous springs occur.

The gaging station was established August 27, 1902. It is located at the highway bridge at Bamfield.

The channel is straight for 500 feet above the station and 800 feet below, with a width at ordinary stages of 140 feet. In the stretch below the station slight riffles occur. The bridge has three spans (one a main Pratt truss span of 92 feet), with flood channels at the ends. One truss is supported on trestle work that is clogged with drift, but only a small portion of the flow passes through this channel at high water. The right bank is skirted by a flood plain, which is, however, seldom overflowed. Beyond the flood plain on the right and close to the river on the left are high gravel banks. The bed of the stream is composed of sand and gravel and is somewhat rough, containing sunken logs and short piles, but is permanent. The velocity is moderate to rapid. The stream seldom freezes over in winter, so that the relation between gage height and discharge differs little from that of summer. Anchor ice backs up the water at times, however.

Discharge measurements are made from the downstream side of the Bamfield highway bridge. The initial point for soundings is the left end of the bridge hand rail at the overflow abutment, downstream side.

The gage, which was read twice daily during 1905 by William H. Bamfield, is a vertical scale attached to the left side of the left pier supporting the main bridge span on the downstream side. The temporary bench mark consists of wire spikes driven into the upstream end of the left pier; elevation above the zero of the gage, 8.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, p 288; 97 pp 434-435; 129, pp 52-53.
Discharge: 83, p 288; 97, p 435; 129, p 53.
Discharge, low-water: 83, p 296.
Discharge, monthly: 129, pp 54-55.
Gage heights: 83, p 289; 97, p 436; 129, p 53.
Rating table: 129, p 54.

Discharge measurements of Au Sable River at Bamfield, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 16	C. C. Covert	143	613	2.66	2.05	1,634
June 7	H. R. Beebe	142	577	2.84	2.18	1,637
November 16	E. F. Weeks	140	535	2.36	1.20	1,266

Daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.45	2.05	2.0	3.1	1.75	1.4	0.9	1.1	0.9	0.95	1.0	1.4
2	3.4	2.05	2.0	2.75	1.95	1.4	.9	1.1	.95	.95	1.0	1.4
3	3.2	2.05	2.0	2.55	2.15	1.5	.95	1.0	1.05	.9	1.1	1.3
4	3.05	2.1	2.0	2.5	2.25	1.5	.95	1.0	1.4	.9	1.2	1.3
5	2.9	2.0	2.0	2.25	2.35	1.5	.95	1.0	1.5	.9	1.2	1.3
6	2.65	1.9	2.0	2.05	2.4	2.0	.9	1.1	1.4	.9	1.2	1.2
7	2.45	1.8	2.0	2.0	2.3	2.1	.95	1.0	1.2	.9	1.3	1.25
8	2.35	1.7	1.95	1.75	2.15	2.15	1.25	1.1	1.15	.9	1.3	1.2
9	2.2	1.6	1.8	1.5	2.15	2.05	1.25	1.1	1.1	.9	1.4	1.3
10	2.2	1.5	1.45	1.3	2.2	2.0	1.0	1.1	1.1	.9	1.5	1.3
11	2.15	1.3	1.35	1.15	2.15	2.0	1.0	1.1	1.0	.9	1.4	1.1
12	2.15	1.2	1.15	1.0	2.05	1.9	1.0	1.1	.95	.9	1.2	1.1
13	2.15	1.15	1.0	1.2	2.0	1.9	1.0	1.1	.95	.9	1.2	1.2
14	2.2	1.1	1.0	1.15	2.05	1.8	1.0	1.1	.95	.9	1.2	1.2
15	2.2	1.1	.9	1.15	2.0	1.5	1.0	1.1	.95	.9	1.2	1.3
16	2.15	1.05	.8	1.2	2.1	1.4	1.0	1.1	.9	.9	1.1	1.4
17	2.15	1.05	.8	1.3	2.3	1.4	1.0	1.1	1.2	.95	1.1	1.2
18	2.1	1.1	.95	1.4	2.15	1.5	1.0	1.1	1.1	1.1	1.1	1.2
19	2.1	1.1	.95	1.45	2.25	1.6	1.0	1.15	1.05	1.1	1.1	1.0
20	2.1	1.25	1.0	1.45	2.05	1.5	1.0	1.4	1.1	1.0	1.1	1.0
21	2.1	1.5	1.25	1.6	1.85	1.5	1.05	1.3	1.0	1.0	1.1	1.0
22	2.1	1.6	1.85	1.7	1.8	1.4	1.3	1.2	.9	1.0	1.1	1.1
23	2.1	1.7	2.35	1.7	1.7	1.4	1.4	1.2	.9	1.0	1.0	1.1
24	2.1	1.7	3.1	1.6	1.7	1.4	1.0	1.1	.9	1.0	1.0	1.1
25	2.0	1.9	3.3	1.7	1.7	1.4	1.0	1.1	.9	1.0	1.15	1.1
26	2.05	1.9	3.35	1.7	2.0	1.1	1.0	1.0	.9	.9	1.5	1.1
27	2.05	1.95	3.45	1.7	1.9	1.0	1.0	1.0	.9	1.0	1.4	1.0
28	2.1	2.0	3.45	1.7	1.5	1.0	1.4	1.0	.9	.9	1.4	1.0
29	2.0	.....	3.45	1.7	1.65	1.0	1.4	.9	.95	.9	1.4	.9
30	2.05	.....	3.5	1.7	1.5	1.0	1.3	.8	.9	.9	1.4	.9
31	2.05	.....	3.3	.....	1.5	.....	1.3	.9	.....	.9	.....	1.0

NOTE.—River frozen over January 1 to March 6. Thickness of ice increased from 1 foot to 2 feet.

Station rating table for Au Sable River at Bamfield, Mich., from August 27, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Gage Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	875	1.40	1,300	2.30	1,830	3.40	2,650
0.60	919	1.50	1,340	2.40	1,900	3.60	2,810
0.70	963	1.60	1,400	2.50	1,960	3.80	2,970
0.80	1,000	1.70	1,460	2.60	2,040	4.00	3,130
0.90	1,050	1.80	1,520	2.70	2,110	4.20	3,300
1.00	1,100	1.90	1,570	2.80	2,190	4.40	3,480
1.10	1,140	2.00	1,630	2.90	2,260	4.60	3,650
1.20	1,200	2.10	1,700	3.00	2,340	4.80	3,840
1.30	1,240	2.20	1,760	3.20	2,490	5.00	4,020

The above table is applicable only for open-channel conditions. It is based on discharged measurements made during 1902-1905. It is fairly well defined between gage heights 0.7 foot and 3.5 feet. Above gage height 3.5 feet the rating curve is based on logarithmic extension.

Estimated monthly discharge of Au Sable River at Bamfield, Mich., for 1905.

[Drainage area, 1,425 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 7-31	2,730	1,000	1,703	1.20	1.12
April	2,410	1,100	1,478	1.04	1.16
May	1,900	1,340	1,631	1.14	1.31
June	1,730	1,100	1,379	.968	1.08
July	1,300	1,050	1,133	.795	.916
August	1,300	1,000	1,134	.796	.918
September	1,340	1,050	1,114	.782	.872
October	1,140	1,050	1,069	.750	.865
November	1,340	1,100	1,202	.844	.942
December	1,300	1,050	1,175	.825	.951

RIFLE RIVER BASIN.

RIFLE RIVER NEAR STERLING, MICH.

Rifle River rises in the vicinity of Rose City, in northern Ogemaw County, flows southward and southeastward, and empties into Saginaw Bay about 5 miles below Omer, Arenac County. Its basin, covering about 385 square miles, is long and narrow, having a width of about 3 miles at the mouth of the stream, and comprises a considerable extent of the so-called "jack-pine" lands, which are covered with a light growth of wood. The region is heavily overlain with glacial deposits—sand, overwash gravel, and till. The basin contains numerous small glacial lakes, but there is no controlled storage and a very small percentage of natural water surface. Ramifying tributaries at the headwaters give the stream a relatively large volume at the entrance of West Branch, in T. 21 N., R. 3 E. The region is wild and the stream is undeveloped, but it is being exploited with a view to the transmission of electric power to Saginaw and Bay City.

A temporary gaging station was established November 14, 1905. It is located near Sterling, at Meeker's bridge, in sec. 5, T. 19 N., R. 5 E., and is about 4 miles upstream from Omer, where a gaging station was formerly maintained. No important tributaries enter between the two points.

The bed of the stream at the station is of fine, shifting sand. The flow is confined underneath the bridge at all stages. A few miles above the station the river makes a rapid descent over a rock bed.

The gage, which was read by G. H. Meeker, is in two sections, each consisting of a 5-foot scale of enameled iron. The lower section is attached to the pile at the right-hand end of the bridge, downstream side; the upper section, reading from 5 to 10 feet, is attached to the docking at the left-hand end of the bridge, upstream side.

A discharge measurement made November 14, 1905, by Horton and Weeks showed a flow of 246 second-feet at gage height 2.10 feet.

Daily gage height, in feet, of Rifle River near Sterling, Mich., for 1905.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
3	.....	2.47	10	.....	2.45	17	.....	2.54	24	2.54	.....
4	.....	2.32	11	.....	2.31	18	.....	2.4	25	2.36	.....
5	.....	2.23	12	.....	2.29	19	.....	2.4	26	2.4	.....
6	.....	2.46	13	.....	2.25	20	.....	2.4	27	2.4	.....
7	.....	2.4	14	.....	2.2	21	.....	2.34	28	2.34	.....
8	.....	2.42	15	.....	2.35	22	.....	2.53	29	2.42	.....
9	.....	2.35	16	.....	2.48	23	.....	2.48	30	2.48	.....

MISCELLANEOUS MEASUREMENTS.

The measurements described below were made by Prof. J. B. Davis in the fall of 1905, at a time when the Rifle was at or very near the lowest stage reached during the year. The area of the stream section was determined by soundings in two, three, or four cross sections 50 feet apart. Surface floats consisting of pieces of paper were used, and the time consumed in passing each cross section was noted. The trials of the floats were repeated until the velocity of the most swiftly moving surface filament was determined. The mean velocity of the cross section was taken as 0.8 of the maximum surface velocity.

First measurement.—Date, September 1, 1905; locality, main river above mouth of West Branch, near the east-west half quarter line in the NW. ¼ sec. 3, T. 21 N., R. 3 E.; number of cross sections measured, four; number of trials of floats, four. The lower section was omitted because of dead water on one end of it; the three remaining sections differed considerably in shape; discrepancies in intervals between sections appeared from records The approximate discharge as adopted is 131 cubic feet per second.

Second measurement.—Date, September 1, 1905; locality, West Branch about 30 rods above mouth; number of cross sections measured, two; number of trials of float, five. The discharge as computed separately for each of the two float sections is as follows: Lower section, area 30.5 square feet, discharge 66 second-feet; upper section, area 27.5 square feet discharge 66 second-feet.

Third measurement.—Date, September 3, 1905; locality, main river below West Branch and other inflows, in the NW. ¼ NE. ¼ sec. 21, T. 21 N., R. 3 E.; number of cross sections measured, three; number of trials of float, eight. There was some interference from wind. The discharge as computed separately for each of the three float sections was as follows: Upper section, area 122 square feet, discharge 234 second-feet; middle section, area 124 square feet, discharge 239 second-feet; lower section, area 134 square feet, discharge 232 second-feet.

Fourth measurement.—Date, September 4, 1905; locality, main river at the NE. ¼ SE. ¼ sec. 25, T. 20 N., R. 3 E.; number of cross sections measured, three; number of trials of float, six. There was no wind at any time. The discharge as computed separately for each of the three float sections was as follows: Upper section, area 123 square feet, discharge 266 second-feet; middle section, area 126 square feet, discharge 269 second-feet; lower section, area 130 square feet, discharge 270 second-feet.

Two discharge measurements of Rifle River were made during 1905 at the Detroit and Mackinac Railway bridge near Omer, Mich., where a gaging station was formerly maintained.

Discharge measurements of Rifle River at Omer, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 17	C. C. Covert	76	290	1.91	6.50	555
June 6	H. R. Beebe	70	234	1.96	6.10	460

SAGINAW RIVER BASIN.

TITTABAWASSEE RIVER AT FREELAND, MICH.

Tittabawassee River is the northernmost of the three tributaries which unite to form Saginaw River at Saginaw, the combined catchment areas receiving the drainage from a crescent-shaped region of about 6,000 square miles surrounding Saginaw Bay. Tittabawassee River drains a region relatively flat, with clay soil predominating and with occasional sand patches, the glacial sands and clay overlying the rock of the Coal Measures to a depth of several hundred feet. The area is largely cleared and under cultivation. From railroad profiles it is estimated that the fall of the stream from Highwood to its mouth, a distance of about 50 miles along the river, is 140 feet.

The gaging station was established August 22, 1903. It is located at the Freeland highway bridge, 10 miles northwest of Saginaw, in sec 21, T. 13 N., R. 3 E., one-half mile from Freeland.

The channel is straight both above and below the station. The right bank has a flood plain which is inundated only at extreme flood stages; the left bank is high and smooth and is not subject to overflow. The bridge consists of two main spans, 320 feet between abutments, an auxiliary trestle span of 150 feet, and two overflow channels under the highway some distance from the right end of the bridge. The bed of the stream is composed of clay and cobblestones and is fairly permanent, but tends to cut near the left bank. The current is uniform and has a medium velocity. It may be affected at times by strong winds, which have a free sweep through the valley.

Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is the left end of the hand rail on the downstream side.

A standard chain gage, which was read twice each day during 1905 by W. E. Dennison, is bolted to the upstream side of the iron guard rail of the bridge, 180 feet from the left end. The length of the chain from the end of the weight to the marker is 31.33 feet. The gage is referred to bench marks as follows: (1) The top of a nail head 1 foot below the top of the cedar corner post of the road fence in front of the blacksmith's shop on the left bank; elevation above gage datum, 32.96 feet. (2) A circle inclosing the letters "B. M.," painted on the top of the downstream end of the left pier; elevation above gage datum, 22.88 feet. The elevation of the top of the gage pulley is 31.33 feet and that of the reference point, the top of the hand rail over the pulley, is 31.50 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 431-432; 129, pp 56-57.
Discharge: 97, p 432; 129, p 57.
Gage heights: 97, p 432; 129, p 58.

Discharge measurements of Tittabawassee River at Freeland, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.[a]
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 18	C. C. Covert	269	2,469	2.69	7.76	5,853
June 5	H. R. Beebe	228	1,055	1.43	2.80	1,513
June 9	do	695	5,228	2.64	12.45	13,780
June 9	do	695	4,688	2.68	12.02	12,550
June 10	do	483	3,248	2.87	10.85	9,328
June 11	do	370	2,726	3.07	10.30	8,480
June 12	do	317	2,563	3.14	9.70	8,048
June 13	do	275	2,166	2.59	8.41	5,618
June 13	do	264	2,111	2.58	8.18	5,476
November 15	Horton and Weeks	226	1,132	1.07	2.52	[b] 1,214

[a] Discharge corrected for angle determined from measurements above 10.0 feet on gage.
[b] No correction for angle.

Daily gage height, in feet, of Tittabawassee River at Freeland, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.7	3.11	9.35	5.85	4.8	2.12	2.05	1.88	1.7	2.25	4.8
2	2.62	2.68	3.12	8.52	5.15	4.2	2.15	2.18	1.92	1.75	2.28	5.38
3	2.58	2.7	3.15	8.45	5.05	3.75	2.28	2.18	2.11	1.82	2.32	5.72
4	2.5	2.72	3.2	8.1	6.58	3.15	2.48	2.08	2.55	1.92	2.38	5.68
5	2.32	2.7	3.25	7.95	8.45	2.8	2.65	1.98	2.92	2.0	2.58	5.55
6	2.3	2.62	3.22	7.75	10.0	6.55	2.95	1.88	2.75	2.08	2.82	5.42
7	2.31	2.55	3.25	7.02	9.65	12.5	3.25	1.8	2.52	2.0	3.1	5.25
8	2.31	2.6	3.28	6.0	8.85	13.65	3.38	1.78	2.26	1.95	3.3	5.0
9	2.31	2.62	3.3	5.1	7.6	12.38	3.4	1.7	2.12	1.9	2.82	4.52
10	2.35	2.68	3.3	4.78	6.9	10.8	3.32	1.8	2.1	1.82	2.72	3.98
11	2.36	2.71	3.28	4.58	6.55	10.31	3.31	1.9	2.52	1.92	2.72	3.22
12	2.34	2.72	3.25	4.35	7.3	9.86	3.35	1.88	2.1	1.9	2.85	2.92
13	2.3	2.7	3.25	4.15	7.55	7.85	3.42	1.8	1.88	1.82	2.65	2.65
14	2.28	2.7	3.25	4.08	7.78	6.28	3.38	1.75	1.78	1.82	2.68	2.51
15	2.35	2.72	3.28	4.05	8.5	5.2	3.28	1.8	1.7	1.8	2.58	2.48
16	2.4	2.7	3.4	3.7	7.42	4.8	3.2	1.85	1.7	1.88	2.55	2.42
17	2.42	2.7	4.32	3.52	7.58	4.45	3.05	1.95	1.9	2.22	2.5	2.48
18	2.42	2.72	5.41	3.48	7.6	4.85	2.78	2.32	2.8	2.72	2.35	2.68
19	2.41	2.76	6.5	3.45	7.05	6.3	2.48	2.75	2.9	3.32	2.22	2.78
20	2.5	2.8	7.2	3.45	6.35	5.25	2.3	3.05	2.68	4.28	2.2	2.98
21	2.51	2.84	7.85	3.6	5.08	4.42	2.22	3.0	2.5	4.38	2.22	3.08
22	2.56	2.91	8.35	3.72	4.85	3.62	2.18	2.9	2.32	4.3	2.15	3.22
23	2.59	2.95	9.5	3.62	4.15	3.12	2.08	2.65	2.15	4.05	2.15	3.31
24	2.55	3.0	11.97	3.58	4.0	2.75	2.0	2.15	1.92	3.72	2.22	3.25
25	2.59	3.08	13.4	3.45	3.9	2.55	1.9	1.98	1.88	3.16	2.35	3.2
26	2.6	3.12	14.58	3.28	3.75	2.5	1.85	1.9	1.8	2.9	2.5	3.16
27	2.62	3.12	12.55	3.15	3.95	2.35	1.91	1.9	1.75	2.8	2.62	3.12
28	2.6	3.1	11.3	3.05	3.85	2.2	1.95	1.82	1.82	2.68	2.78	3.15
29	2.64	.....	10.12	4.58	3.8	2.15	2.0	1.8	1.8	2.38	3.05	3.38
30	2.68	.....	9.5	6.5	4.2	2.18	2.0	1.8	1.75	2.3	3.28	3.68
31	2.68	.....	9.78	.....	5.15	.....	1.95	1.82	.....	2.26	.....	3.68

NOTE.—River frozen over January 1 to March 24. Thickness of ice approximately 1 foot.

LAKE ERIE DRAINAGE.

GENERAL FEATURES.

That portion of the Lake Erie drainage basin that lies within the United States, exclusive of Lakes Superior, Michigan, and Huron, covers the northern third of Ohio, a small corner of northeastern Indiana, and a similar area in southeastern Michigan. South of the lake the drainage area is narrow, the divide lying in places scarcely 50 miles back from the lake shore. To the west the width of the area is greater, and the Maumee, which enters the lake near Toledo, is the largest stream of northern Ohio. The average altitude of the watershed above Lake Erie is 500 feet, but the head of the Maumee at Fort Wayne, Ind., is only 170 feet above the lake. The surface is level or gently rolling.

The principal streams are Huron and Raisin rivers, which enter the lake from the Michigan corner, and Maumee, Black, and Cuyahoga rivers, which enter from Ohio. Of these the Maumee, formed by the junction of St. Marys and St. Joseph rivers at Fort Wayne, Ind., is the most important.

The work of the United States Geological Survey during 1905 in the Lake Erie drainage basin is set forth in the following pages:

HURON RIVER BASIN.

DESCRIPTION OF BASIN.

Huron River rises near the central part of Oakland County, Mich., flows southwestward, then southeastward, and is tributary to the west end of Lake Erie near the mouth of Detroit River. The Huron receives the drainage from an irregularly shaped basin having its greatest length parallel to and lying at a distance of 25 to 30 miles from Detroit River. This basin is connected with Lake Erie by a long, narrow valley, averaging 5 miles in width, extending from a point near Ypsilanti southeastward to Lake Erie, a distance of 28 miles. In this portion of its course a large part of the total fall of the river occurs. The conditions are thus nearly ideal for the development of water power, in that nearly the entire catchment area, all the large tributaries, and an extensive area affording lake and ground storage lie above the head of this narrow valley.

The northern portion of the main catchment area is rolling and its topography is complex. The stream flows through a series of lakes, and north of Dover the entire basin is largely composed of lakes and surrounding marshes. In the vicinity of Ann Arbor the topography is very rolling. The stream has here a broad, flat valley, bordered by abrupt hills ranging in height from 100 to 200 feet. The channel is tortuous and changeable. Numerous abandoned sections remain as bayous. Large springs issue from the morainal hills.

Below Ypsilanti the drainage basin is flat, the soil, comparatively heavy and impervious, in mostly under cultivation, and the ground-water level is controlled by numerous drain trenches.

HURON RIVER AT DEXTER, MICH.

This station was established September 1, 1904. It is located just above the highway bridge in the village of Dexter.

A boat and cable section was selected a short distance below the highway bridge, and current-meter measurements have been made, as indicated in the accompanying table.

A vertical gage scale, divided decimally, was erected for use during low water. The gage is located just above a rapid, where it will be less affected by freezing than elsewhere. The record has been kept by the Washtenaw Electric Company, and has been furnished by R. W. Hemphill, manager.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 129, United States Geological Survey, pages 63–64.

Discharge measurements of Huron River at Dexter, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height	Discharge
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
May 12 [a]	R. E. Horton	177	519	3.07	3.20	1,5[illegible]
May 31 [b]	H. R. Beebe	116	335	1.31	1.35	[illegible]
November 13 [b]	R. E. Horton	125	438	1.33	1.70	5[illegible]3

[a] Measurement at highway bridge. [b] Measurement made from boat.

Daily gage height, in feet, of Huron River at Dexter, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.5	1.7	2.75	1.42	1.25	1.35	1.38	1.15	1.35	1.45	2.4
2	1.3	1.7	1.62	2.62	1.4	1.22	1.45	1.35	1.15	1.38	1.4	2.05
3	1.45	1.9	1.6	2.48	1.35	1.15	1.48	1.3	1.15	1.5	1.4	2.0
4	1.55	1.85	1.6	2.3	1.3	1.15	1.52	1.35	1.15	1.5	1.35	1.9
5	1.35	1.85	1.55	2.22	1.4	1.2	1.48	1.45	1.15	1.45	1.42	1.88
6	1.3	1.85	1.52	2.15	1.62	2.2	1.35	1.5	1.15	1.45	1.7	1.85
7	1.25	1.8	1.5	2.1	1.85	3.4	1.25	1.48	1.1	1.38	1.82	1.82
8	1.3	1.78	1.5	1.92	1.82	3.7	1.35	1.4	1.1	1.35	1.85	1.8
9	1.6	1.7	1.42	1.8	1.78	3.8	1.35	1.38	1.1	1.35	1.82	1.8
10	1.38	1.7	1.32	1.78	1.75	4.1	1.5	1.3	1.1	1.3	1.8	1.78
11	1.52	1.7	1.28	1.9	2.25	4.32	1.7	1.3	1.05	1.3	1.78	1.7
12	1.8	1.6	1.25	1.85	3.05	4.35	1.72	1.3	1.05	1.3	1.75	1.68
13	1.68	1.7	1.25	1.72	3.15	4.25	1.7	1.28	1.05	1.28	1.68	1.65
14	1.6	1.6	1.25	1.68	2.95	4.0	1.58	1.25	1.05	1.25	1.65	1.58
15	1.65	1.8	1.38	1.58	2.42	3.6	1.5	1.4	1.0	1.18	1.6	1.5
16	1.75	1.8	1.18	1.5	2.28	3.3	1.5	1.38	1.0	1.12	1.58	1.42
17	1.75	1.75	1.5	1.5	2.15	3.05	1.5	1.3	1.45	1.18	1.55	1.4
18	1.62	1.75	2.6	1.45	2.08	2.85	1.5	1.3	1.72	1.52	1.5	1.4
19	1.42	1.7	3.3	1.38	1.95	2.72	1.5	1.25	1.82	1.9	1.5	1.4
20	1.35	1.7	3.5	1.3	1.82	2.55	1.5	1.35	1.8	2.1	1.45	1.4
21	1.25	1.68	3.35	1.85	1.65	2.35	1.48	1.35	1.65	2.05	1.45	1.5
22	1.5	1.65	3.15	2.3	1.5	2.25	1.45	1.28	1.6	1.92	1.4	1.8
23	1.52	1.68	3.0	2.25	1.45	2.05	1.4	1.25	1.6	1.85	1.4	1.8
24	1.32	1.72	3.0	2.05	1.4	1.88	1.38	1.25	1.6	1.82	1.4	1.75
25	1.55	1.7	3.1	1.88	1.35	1.72	1.3	1.25	1.6	1.8	1.4	1.6
26	1.75	1.7	3.1	1.8	1.35	1.68	1.28	1.25	1.55	1.75	1.4	1.6
27	1.65	1.7	2.92	1.8	1.45	1.58	1.22	1.25	1.55	1.68	1.43	1.6
28	1.5	1.7	2.85	1.72	1.3	1.5	1.2	1.2	1.5	1.6	1.65	1.6
29	1.7	.....	2.8	1.65	1.3	1.42	1.3	1.2	1.45	1.55	2.6	1.58
30	1.75	.....	2.9	1.52	1.3	1.35	1.52	1.18	1.4	1.32	2.7	1.5
31	1.6	.....	2.95	.....	1.3	.....	1.48	1.15	.....	1.42	.....	1.45

NOTE.—Partial ice conditions existed during January, February, and March, but were not sufficient to materially modify the flow.

HURON RIVER AT GEDDES, MICH.

A record of the depth of overflow at the dam and of the run of the water wheels in the adjacent electric plant has been maintained at Geddes by the Washtenaw Electric Company since February 1, 1904.

A survey of the dam was made by R. E. Horton for the United States Geological Survey in September, 1904. New gages were erected, and the record has been maintained and furnished to the Survey from that date. This gaging station affords opportunity to determine the discharge during low water in both summer and winter. At times when water flows over the dam the discharge is less certain. The computation of run-off during 1905 given in the accompanying table has been furnished by Gardner S. Williams.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 129, United States Geological Survey, pages 64–65.

Estimated monthly discharge of Huron River, at Geddes, Mich., for 1905.

[Drainage area, 757 square miles.]

Month.	Mean discharge in second-feet.	Run-off.		Rainfall.
		Second-feet per square mile.	Depth in inches.	Inches.
January	204	0.27	0.31	1.6[illegible]
February	170	.23	.24	1.49
March	750	.99	1.14	1.6[illegible]
April	668	.88	.98	2.7[illegible]
May	606	.80	.92	5.56
June	1,106	1.46	1.63	5.67
July	399	.53	.61	4.78

HURON RIVER AT FRENCH LANDING, MICH.

A temporary gage was erected at the Wabash Railroad bridge at Frenchville, Mich., and was maintained for a few weeks during the low-water season of 1903. A new gage was erected August 5, 1904, at the highway bridge at French Landing.

The stream freezes over in winter, and when it is frozen the conditions are unfavorable for the determination of the discharge. The right bank is never overflowed. The highway may be overflowed for a short distance from the bridge during extreme freshets.

The gage, which was read twice each day by F. L. Robbe, consists of a vertical scale, divided decimally, attached to the downstream side of the right-hand bridge abutment. The record is furnished by the Washtenaw Electric Company, of Ann Arbor, Mich.

A discharge measurement, made May 13, 1905, by R. E. Horton, showed a flow of 1,941 second-feet at gage height 7.10 feet.

Regular gage observations at this station were discontinued June 30, 1905.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 129, United States Geological Survey, page 66.

Daily gage height, in feet, of Huron River at French Landing, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	2.38	2.45	3.15	6.0	3.3	2.65	17	2.65	2.45	5.0	3.15	4.65	6.85
2	2.55	1.95	2.75	5.55	3.0	2.65	18	2.6	2.3	6.4	2.95	4.5	6.75
3	2.4	2.4	2.85	5.45	2.8	2.5	19	2.5	1.6	8.95	2.7	4.35	5.45
4	2.25	2.35	2.95	5.1	2.65	2.05	20	2.45	2.3	8.6	2.9	4.1	5.5
5	2.0	2.2	2.7	4.65	2.7	1.85	21	2.65	2.95	7.2	3.9	3.75	4.95
6	2.55	1.35	3.05	4.85	2.95	5.45	22	2.45	2.7	6.7	5.35	3.6	4.75
7	2.18	2.7	3.25	4.8	3.45	9.65	23	2.3	2.5	6.45	5.4	3.35	4.5
8	2.08	2.45	3.2	4.2	3.5	9.0	24	2.7	2.85	6.4	5.15	2.95	3.95
9	2.1	2.45	3.35	4.3	3.95	8.3	25	2.5	2.8	6.5	4.55	2.8	3.6
10	1.85	2.35	3.45	4.05	3.6	8.35	26	2.25	2.6	6.35	4.15	2.9	3.65
11	1.7	2.25	3.75	4.0	4.1	8.7	27	2.05	2.55	6.45	4.15	2.85	3.25
12	2.3	1.95	3.8	4.15	6.2	8.9	28	2.05	2.95	6.4	3.9	2.7	2.9
13	2.55	2.3	3.7	3.95	7.05	8.7	29	2.05	.....	5.7	3.8	2.75	2.5
14	2.35	2.45	3.6	3.8	6.8	8.4	30	1.55	.....	5.7	3.2	2.85	2.6
15	2.3	2.3	3.65	3.45	6.2	8.0	31	2.65	.....	6.05	.....	2.7	.....
16	2.35	2.3	3.7	3.4	5.3	7.25							

NOTE.—River frozen entirely across January 1 to March 20, approximately. Average thickness of ice, 1.5 feet. Gage heights are to water surface in hole in ice.

Station rating table for Huron River at French Landing, Mich., from August 5, 1904, to June 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	62	1.70	323	3.40	769	6.20	1,626
0.10	71	1.80	345	3.50	797	6.40	1,692
0.20	81	1.90	367	3.60	826	6.60	1,758
0.30	91	2.00	390	3.70	855	6.80	1,824
0.40	102	2.10	415	3.80	884	7.00	1,890
0.50	114	2.20	440	3.90	913	7.20	1,958
0.60	126	2.30	466	4.00	942	7.40	2,026
0.70	139	2.40	493	4.20	1,002	7.60	2,094
0.80	153	2.50	520	4.40	1,064	7.80	2,162
0.90	168	2.60	547	4.60	1,126	8.00	2,230
1.00	184	2.70	574	4.80	1,188	8.20	2,300
1.10	202	2.80	601	5.00	1,250	8.40	2,370
1.20	220	2.90	629	5.20	1,312	8.60	2,440
1.30	239	3.00	657	5.40	1,374	8.80	2,510
1.40	259	3.10	685	5.60	1,436	9.00	2,580
1.50	280	3.20	713	5.80	1,498	9.50	2,755
1.60	301	3.30	741	6.00	1,560		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1904-5. It is not well defined, being based on a group of three measurements between 1.5 and 2 feet and one measurement at 7.1 feet. Below 1.5 feet the curve is very uncertain. Estimates based on this table are liable to considerable error above 2 feet and below 1 foot.

Estimated monthly discharge of Huron River at French Landing, Mich., for 1904-5.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1904.			
August 5-31	327	83	215
September	691	20	307
October	547	224	347
November	349	184	250
1905.			
March 21-31	1,958	1,467	1,678
April	1,560	574	1,013
May	1,907	560	902
June	2,808	356	1,434

NOTE.—Ice conditions during December, 1904.

HURON RIVER AT FLATROCK, MICH.

This station was established August 6, 1904. It is located at the highway bridge below Metler's dam at Flatrock, Mich., about 8 miles above the mouth of the stream.

The stream bed is of horizontal rock overlain with sand and gravel. The current, aside from slight eddies and swirls carried by the water from the dam and mill above, is comparatively smooth and uniform. The banks are smooth and are overflowed only in highest freshets, occurring at rare intervals, such, for example, as the flood of March 26, 1904, which overflowed the bank on the right-hand side of the bridge. The stream freezes over but little in winter, owing to the close proximity of the dam.

Discharge measurements are made from the downstream side of the highway bridge. The initial point for soundings is the face of the left abutment, downstream side of bridge.

The gage, which is read twice each day by C. L. Metler, is a vertical scale, divided decimally, attached to the downstream side of the left-hand bridge abutment. The gage datum is referred to the bench mark on the top of the coping stone of the left abutment, immediately over the gage. The gage datum is 14.10 feet below the bench mark.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 129, United States Geological Survey, page 67.

Discharge measurements of Huron River at Flatrock, Mich., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 13	R. E. Horton	100	682	2.54	6.28	1.72[illegible]
May 30	H. R. Beebe	100	296	1.93	2.58	571
November 17	E. F. Weeks	100	304	1.86	2.64	[illegible]

Daily gage height, in feet, of Huron River at Flatrock, Mich., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.4	2.7	5.7	2.45	2.5	2.2	2.3	1.7	1.85	2.4	5.[illegible]
2	1.75	2.35	2.7	5.55	2.95	2.2	2.2	1.95	1.6	1.75	2.15	4.[illegible]
3	2.3	2.2	2.9	5.2	2.6	1.95	2.25	1.85	1.75	2.15	2.1	4.[illegible]
4	2.1	2.3	2.9	5.0	2.45	1.9	2.85	1.8	1.55	2.2	2.2	3.9
5	1.75	2.15	2.85	4.7	2.35	2.1	2.7	1.9	1.6	2.1	2.2	3.[illegible]
6	1.85	2.1	2.65	4.4	2.6	3.8	2.6	2.0	1.8	2.0	2.4	3.7
7	1.75	2.4	2.95	4.2	3.0	7.5	2.3	2.05	1.7	1.95	3.1	3.55
8	1.85	2.3	3.0	4.0	3.4	8.25	2.25	2.15	1.55	1.9	3.55	3.45
9	1.8	2.25	3.05	3.8	3.65	7.8	2.15	2.0	1.5	2.15	3.5	3.5
10	2.5	2.25	3.25	3.75	3.6	7.4	2.15	1.95	1.35	1.95	3.3	3.45
11	2.2	2.25	3.35	3.8	3.7	7.4	2.9	1.85	1.2	1.95	3.3	3.4
12	1.65	2.2	3.4	3.75	5.4	7.7	3.45	1.75	1.5	1.9	3.05	3.35
13	2.2	2.4	3.15	3.8	6.35	7.75	3.95	1.8	1.65	1.9	3.0	3.1
14	2.45	2.35	3.45	3.6	6.55	7.6	3.8	1.65	1.4	1.75	3.1	3.1
15	2.1	2.3	3.3	3.15	6.15	7.4	3.55	3.55	1.35	1.7	3.0	2.[illegible]
16	1.95	2.3	3.3	3.15	5.5	6.95	3.15	2.85	1.25	1.55	2.85	2.35
17	2.55	2.3	3.55	3.0	4.55	6.5	2.8	2.55	1.65	1.8	2.75	2.45
18	2.1	2.25	4.85	3.0	4.3	6.1	2.7	2.15	2.55	1.8	2.65	2.50
19	2.05	2.35	5.95	2.75	4.25	5.55	2.5	1.95	2.55	2.4	2.40	2.7
20	2.05	2.28	7.35	2.45	3.9	5.2	2.35	2.65	2.6	3.1	2.25	2.45
21	2.1	2.45	7.85	3.65	3.65	4.9	2.3	2.3	2.45	3.65	2.55	2.5
22	2.1	2.65	7.6	4.75	3.2	4.6	2.15	2.2	2.1	3.5	2.25	3.45
23	2.15	2.65	6.55	5.0	3.2	4.15	2.15	1.95	2.05	3.4	2.2	3.9
24	2.55	2.55	6.0	4.9	2.85	4.0	2.05	1.9	2.1	3.3	2.3	3.7
25	2.45	2.7	6.05	4.5	2.65	3.55	2.2	1.9	2.05	3.0	2.3	2.65
26	2.55	2.7	6.1	4.0	2.55	3.35	1.9	1.8	2.3	3.0	2.1	2.8
27	2.7	2.45	5.95	3.85	2.55	3.3	1.9	1.75	2.1	2.85	2.15	3.1
28	2.35	2.9	5.85	3.75	2.45	2.9	2.25	1.65	2.05	2.75	2.5	3.0[illegible]
29	2.3	.....	5.5	3.55	2.3	2.7	1.7	.....	2.0	2.7	3.3	3.05
30	2.4	.....	5.45	3.3	2.65	2.4	1.85	1.65	1.95	2.35	5.5	2.9
31	2.35	.....	5.58	.....	2.35	.....	2.3	1.6	.....	2.6	.....	2.7[illegible]

NOTE.—Partial ice conditions during the winter months.

Station rating table for Huron River at Flatrock, Mich., from August 5, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	95	1.80	379	3.30	748	5.60	1,476
0.40	108	1.90	401	3.40	774	5.80	1,550
0.50	124	2.00	424	3.50	801	6.00	1,624
0.60	141	2.10	447	3.60	828	6.20	1,699
0.70	158	2.20	471	3.70	856	6.40	1,775
0.80	176	2.30	495	3.80	884	6.60	1,852
0.90	194	2.40	519	3.90	913	6.80	1,930
1.00	213	2.50	543	4.00	942	7.00	2,010
1.10	232	2.60	568	4.20	1,002	7.20	2,090
1.20	252	2.70	593	4.40	1,064	7.40	2,170
1.30	272	2.80	618	4.60	1,128	7.60	2,252
1.40	293	2.90	644	4.80	1,194	7.80	2,334
1.50	314	3.00	670	5.00	1,261	8.00	2,416
1.60	335	3.10	696	5.20	1,331	8.20	2,500
1.70	357	3.20	722	5.40	1,403		

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1904-5. It is well defined between gage heights 0.3 foot and 2.6 feet.

Estimated monthly discharge of Huron River at Flatrock, Mich., for 1904-5.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1904.			
August 6-31	335	89	209
September [a]	580	232	320
October	447	282	351
November	346	262	292
December	543	242	313
1905.			
January	593	346	463
February	644	447	515
March	2,354	580	1,149
April	1,513	531	957
May	1,832	495	846
June	2,521	401	1,340
July	928	357	548
August [a]	814	335	434
September	568	252	389
October	842	324	513
November	1,439	447	612
December	1,476	507	753
The year	2,521	252	710

[a] Discharge interpolated September 14, 1904, and August 29, 1905.

NOTE.—No correction made for ice conditions during the winter months.

MAUMEE RIVER BASIN.

DESCRIPTION OF BASIN.

Maumee River is formed at Fort Wayne, Ind., by the junction of St. Joseph and St. Marys rivers and flows northeastward into Lake Erie at Toledo. The chief tributaries are Auglaize and Tiffin rivers. The total drainage area is 6,723 square miles. The country is flat and the river has not worn its valley very deep. The stream is about 600 feet wide at South Toledo, the depth ranging from 1 foot to 6 or 7 feet. The stream is subject to high freshets. The bed is of rock, up to Defiance at least, and the banks are of clay and gravel.

MAUMEE RIVER NEAR SHERWOOD, OHIO.

This station was established May 19, 1903. It is located at the highway bridge 2.5 miles south of Sherwood, Ohio, and 200 feet upstream from the Cincinnati Northern Railroad bridge.

The channel is straight for 1,000 feet above and 500 feet below the station. Both banks are high and clean, and both may overflow at extremely high water. The bed of the stream consists of clay and gravel and some silt. There is one channel at all stages. The current is sluggish at extremely low water.

Discharge measurements are made from the two-span highway bridge, which has a total length of 300 feet between abutments. The initial point for soundings is the face of the south abutment.

The inclined gage which was established on the bank under the north end of the bridge was destroyed. A regulation chain gage, which was read during 1905 by George J. Coffin, was installed May 19, 1903. This is bolted to the hand rail of the bridge on the upstream side 200 feet from the south abutment. The length of the chain from the end of the weight to the marker is 28.88 feet. The gage is referred to bench marks as follows: (1) A copper bolt in the stepping stone of the west wing wall of the north abutment; stone is in tier just below top tier; elevation above zero of gage, 22.30 feet. (2) A cut in the iron hand rail directly over the pulley of the gage; elevation above gage zero, 29.69 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 429; 129, p 68.
Discharge: 97, p 429; 129, p 68.
Discharge, monthly: 129, pp 70-71.
Gage heights: 97, p 429; 129, p 69.
Rating table: 129, p 70.

Discharge measurements of Maumee River near Sherwood, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 25	M. S. Brennan	250	928	1.44	3.96	1,332
July 12	S. K. Clapp	251	1,146	1.72	4.82	1,9[illegible]
October 28	R. W. Pratt	249	608	.74	2.62	4[illegible]
November 22	do	248	465	.55	2.15	[illegible]

Daily gage height, in feet, of Maumee River near Sherwood, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	.....	8.1	7.0	5.2	3.6	2.45	2.05	2.25	2.3	2.2	8.0
2	4.0	2.8	9.1	6.4	4.6	3.3	2.45	2.1	2.25	2.2	2.2	7.5
3	3.8	.....	9.2	4.8	4.3	2.9	2.4	2.15	2.2	2.2	2.15	7.0
4	3.5	.....	9.2	4.0	4.3	2.9	2.3	2.15	2.15	2.2	2.1	5.6
5	3.3	.....	9.0	3.8	4.8	3.2	2.4	2.15	2.15	2.2	2.1	5.0
6	3.2	.....	8.8	3.6	5.2	7.4	2.75	2.15	2.15	2.2	2.1	4.5
7	3.15	.....	8.6	3.6	5.1	6.8	2.75	2.15	2.15	2.2	2.2	4.0
8	3.1	.....	8.6	3.5	5.2	6.0	2.55	2.1	2.15	2.2	2.5	3.8
9	3.1	.....	8.6	3.2	4.9	5.5	2.6	2.05	2.15	2.2	2.7	3.5
10	3.1	2.7	8.7	3.25	4.6	5.0	2.8	2.0	2.15	2.2	2.8	3.4
11	3.1	.....	8.9	3.4	8.3	12.0	3.4	2.0	2.15	2.15	2.8	3.2
12	3.4	.....	8.9	3.6	15.2	14.7	4.75	2.0	2.15	2.1	2.8	3.2
13	3.4	.....	9.0	4.0	18.0	11.5	4.35	1.95	2.15	2.05	2.8	3.15
14	3.9	.....	8.5	4.2	17.4	9.0	4.0	1.95	2.15	2.0	2.7	3.1
15	3.9	.....	7.6	4.2	16.8	7.0	3.8	1.95	2.15	2.0	2.6	3.05
16	3.8	.....	6.2	3.8	15.2	6.6	3.4	2.05	2.15	2.0	2.5	3.0
17	3.7	2.6	5.5	3.6	13.2	6.2	3.0	2.5	2.15	2.0	2.4	2.9
18	3.7	.....	5.6	3.4	11.7	6.0	2.8	2.5	3.05	2.0	2.3	2.9
19	3.65	.....	7.1	3.3	10.0	5.3	2.7	2.5	3.4	2.05	2.3	2.85
20	3.6	.....	7.9	3.25	8.5	4.8	2.65	2.4	3.4	2.1	2.2	2.85
21	3.6	.....	7.8	5.9	7.2	4.0	2.55	2.5	3.4	2.1	2.2	2.9
22	3.4	.....	7.6	10.6	6.0	3.8	2.5	2.55	3.7	2.3	2.15	4.2
23	3.2	.....	7.6	11.3	5.1	4.1	2.3	2.5	3.75	2.5	2.15	6.5
24	3.2	2.8	7.8	10.2	4.6	4.6	2.2	2.5	3.75	3.5	2.1	6.5
25	3.2	2.9	7.8	8.7	3.9	4.7	2.1	2.5	3.75	3.5	2.1	6.3
26	3.1	3.0	7.0	7.8	3.6	3.9	2.05	2.5	3.85	3.3	2.1	5.8
27	3.1	4.2	6.3	7.5	3.3	3.6	2.0	2.5	3.25	2.8	2.15	5.1
28	3.05	6.1	5.4	7.1	3.25	3.3	2.0	2.5	2.85	2.5	3.3	4.8
29	2.9	.....	5.2	6.1	3.3	2.8	2.0	2.85	2.75	2.4	7.5	4.5
30	2.8	.....	5.1	5.6	3.3	2.55	2.0	2.65	2.35	2.3	8.0	4.5
31	2.8	.....	6.5	.....	4.0	.....	2.0	2.50	.....	2.3	.....	4.4

NOTE.—River frozen entirely across both above and below gage January 1 to February 28. The ice gradually broke up March 1-10, approximately. During this period gage heights are to the water surface in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 2	2.8	2.9	1.3
February 17	2.6	2.7	1.6
February 24	2.8	2.9	1.4
February 26	3.0	3.1	1.4

Station rating table for Maumee River near Sherwood, Ohio, from May 19, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	80	3.80	1,205	5.70	2,630	9.00	5,430
1.90	110	3.90	1,275	5.80	2,710	9.20	5,610
2.00	145	4.00	1,345	5.90	2,790	9.40	5,790
2.10	185	4.10	1,415	6.00	2,870	9.60	5,970
2.20	230	4.20	1,485	6.20	3,030	9.80	6,170
2.30	280	4.30	1,555	6.40	3,190	10.00	6,370
2.40	330	4.40	1,625	6.60	3,350	10.50	6,870
2.50	380	4.50	1,695	6.80	3,510	11.00	7,370
2.60	440	4.60	1,765	7.00	3,670	11.50	7,920
2.70	500	4.70	1,835	7.20	3,830	12.00	8,470
2.80	560	4.80	1,910	7.40	3,990	12.50	9,020
2.90	620	4.90	1,990	7.60	4,170	13.00	9,580
3.00	680	5.00	2,070	7.80	4,350	13.50	10,180
3.10	740	5.10	2,150	8.00	4,530	14.00	10,780
3.20	800	5.20	2,230	8.20	4,710	15.00	12,080
3.30	860	5.30	2,310	8.40	4,890	16.00	13,380
3.40	925	5.40	2,390	8.60	5,070	17.00	14,780
3.50	995	5.50	2,470	8.80	5,250	18.00	16,280
3.60	1,065	5.60	2,550				
3.70	1,135						

The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1903-1905. It is well defined between gage heights 1.8 feet and 6.2 feet. Above 6.2 feet it is determined by one high-water measurement.

Estimated monthly discharge of Maumee River near Sherwood, Ohio, for 1905.

[Drainage area, 2,190 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 11-31	5,430	2,150	3,796	1.73	1.35
April	7,700	800	2,471	1.13	1.26
May	16,280	830	4,582	2.09	2.41
June	11,690	410	2,709	1.24	1.38
July	1,870	145	534	.244	.281
August	590	125	280	.128	.148
September	1,240	205	508	.232	.259
October	995	145	307	.140	.161
November	4,530	185	596	.272	.304
December	4,530	590	1,727	.789	.910

ST. JOSEPH RIVER AT FORT WAYNE, IND.

St. Joseph River rises in the southern part of Michigan, flows southwestward into Indiana, and at Fort Wayne unites with St. Marys River to form the Maumee.

The gaging station was established March 20, 1905. It is located on the first highway bridge about 1 mile above the junction with St. Marys River.

The channel is straight for 1,000 feet above and below the station. Both banks are high, alluvial, and not subject to overflow. About 300 feet below the bridge are remnants

of an old dam, which at low stages divert most of the water to the right side of the stream, where the channel is deepened. There is but one channel at all stages. The bed of the stream is composed of coarse gravel and is free from vegetation and permanent. High water in St. Marys River without a corresponding stage in St. Joseph River might cause backwater at this station, but the occurrence would be rare. There is a dam on the river about 4 miles above the bridge and a small amount of water is diverted around the station by means of a canal.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. The bridge has a length of 213 feet. The initial point for soundings is the inner face of the right abutment, downstream side.

A standard chain gage, which was read during 1905 by Edward Towsley, is attached to the downstream side of the bridge, near the middle of the stream. The length of the chain from the end of the weight to the end of the last copper link is 26.24 feet. The gage is referred to bench marks as follows: (1) On the end of the outer end coping stone of the downstream wing of the left abutment, one-half foot from the downstream eastern edge of the stone; elevation above gage datum, 22.55 feet. (2) The top of the downstream lower truss chord opposite the pulley of the gage; elevation above gage datum, 25.00 feet.

Discharge measurements of St. Joseph River at Fort Wayne, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 20	Hanna and Clapp	170	939	3.55	6.29	3,331
May 26	M. S. Brennan	160	348	1.56	3.04	544
July 13	S. K. Clapp	160	511	1.94	3.65	992
August 22	M. S. Brennan	150	214	.45	2.00	97
October 4	do	153	214	.51	2.10	110
December 7	do	159	374	1.17	2.99	436

Daily gage height, in feet, of St. Joseph River at Fort Wayne, Ind., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.0	3.3	3.1	2.7	2.25	2.3	2.2	2.4	5.55
2		4.45	3.05	3.0	2.65	2.2	2.3	2.25	2.35	4.6
3		4.0	2.9	2.9	2.6	2.2	2.3	2.1	2.35	4.0
4		3.6	2.7	2.8	2.7	2.15	2.25	2.1	2.3	3.4
5		3.3	2.7	4.9	3.0	2.15	2.2	2.0	2.3	3.2
6		3.15	2.8	4.15	2.85	2.2	2.2	2.0	2.45	3.1
7		3.05	3.6	5.2	2.85	2.15	2.3	2.0	2.4	3.0
8		2.9	3.9	4.4	2.8	2.15	2.2	1.9	2.35	2.95
9		2.85	3.8	4.2	2.7	2.15	2.2	1.8	2.6	2.9
10		2.8	3.5	4.1	2.85	2.15	2.1	1.8	2.8	3.0
11		2.95	4.0	10.6	3.8	2.15	2.2	1.75	2.7	3.1
12		3.6	15.0	7.8	3.7	2.15	2.2	1.75	2.65	2.8
13		4.05	14.4	7.1	3.7	2.1	2.2	1.7	2.6	2.7
14		3.8	13.9	5.6	3.45	2.1	2.2	1.7	2.5	2.6
15		3.5	12.1	5.0	3.2	2.1	2.15	1.7	2.5	2.5
16		3.3	10.2	4.7	2.9	2.05	2.25	1.7	2.45	2.4
17		3.25	8.8	4.3	2.75	2.05	2.25	1.7	2.45	2.5
18		3.1	7.4	4.05	2.65	2.05	2.25	1.8	2.45	2.5
19		2.85	6.3	3.5	2.6	2.05	2.3	1.9	2.4	2.45
20	6.3	2.8	5.3	3.35	2.5	2.0	2.25	1.9	2.4	2.4
21	6.4	6.7	4.45	3.1	2.45	2.0	2.25	3.45	2.35	2.95
22	6.1	8.4	4.1	3.9	2.35	2.0	2.2	3.45	2.35	4.45
23	6.0	8.1	3.6	4.45	2.3	1.9	2.2	3.45	2.35	4.95

Daily gage height, in feet, of St. Joseph River at Fort Wayne, Ind., for 1905—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
24	6.2	6.8	3.35	4.5	2.3	2.0	2.25	3.25	2.3	4.45
25	5.9	6.0	3.15	3.7	2.3	2.2	2.3	3.0	2.3	3.95
26	5.2	5.6	3.0	3.55	2.3	2.25	2.25	2.8	2.3	3.65
27	4.7	5.1	2.9	3.2	2.25	2.75	2.2	2.7	2.3	3.4
28	4.3	4.25	2.8	3.0	2.25	2.75	2.1	2.65	2.4	3.3
29	3.9	3.8	2.75	2.9	2.2	2.65	2.1	2.55	7.0	3.3
30	4.45	3.5	3.0	2.7	2.25	2.4	2.1	2.5	6.0	3.2
31	5.2	.....	3.2	.....	2.3	2.3	.....	2.45	.....	3.25

NOTE.—Gage heights interpolated August 13–21.

Station rating table for St. Joseph River at Fort Wayne, Ind., from March 20 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	30	3.50	825	5.30	2,270	7.00	4,150
1.80	50	3.60	890	5.40	2,365	7.20	4,410
1.90	70	3.70	960	5.50	2,460	7.40	4,670
2.00	95	3.80	1,030	5.60	2,560	7.60	4,940
2.10	120	3.90	1,100	5.70	2,660	7.80	5,220
2.20	150	4.00	1,175	5.80	2,760	8.00	5,500
2.30	185	4.10	1,250	5.90	2,860	8.20	5,800
2.40	225	4.20	1,330	6.00	2,970	8.40	6,100
2.50	270	4.30	1.410	6.10	3,080	8.60	6,400
2.60	315	4.40	1,490	6.20	3,190	8.80	6,700
2.70	365	4.50	1.570	6.30	3,300	9.00	7,000
2.80	415	4.60	1,655	6.40	3,420	10.00	8,600
2.90	470	4.70	1,740	6.50	3,540	11.00	10,300
3.00	525	4.80	1,825	6.60	3,660	12.00	12,100
3.10	580	4.90	1,910	6.70	3,780	13.00	14,000
3.20	640	5.00	2,000	6.80	3,900	14.00	16,000
3.30	700	5.10	2,090	6.90	4,020	15.00	18,100
3.40	760	5.20	2,180				

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 2 feet and 6.3 feet.

Estimated monthly discharge of St. Joseph River at Fort Wayne, Ind., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean
March 20–31	3,420	1,100	2,413
April	6,100	415	1,544
May	18,100	365	3,380
June	9,620	365	1,654
July	1,030	150	394
August	390	70	154
September	185	120	157
October	792	30	224
November	4,150	185	462
December	2,510	225	760

ST. MARYS RIVER AT FORT WAYNE, IND.

St. Marys River rises in the western part of Ohio, flows northwestward, and unites with St. Joseph River at Fort Wayne to form the Maumee.

The gaging station was established March 20, 1905. It is located on the Taylor Street Bridge, in Fort Wayne, about 2.5 miles above the junction of the stream with the St. Joseph.

The channel is straight for 1,000 feet above and below the station. Both banks are high, alluvial, and not subject to overflow. The bed of the stream is composed of coarse gravel and is free from vegetation and permanent. There is but one channel at all stages. The current is swift and direct.

Discharge measurements are made from the upstream side of the single-span bridge to which the gage is attached. The length of the bridge between abutments is 166 feet. The initial point for soundings is the inner face of the right abutment, upstream side.

A standard chain gage, which was read during 1905 by Clement S. Graham, is nailed to the downstream side of the bridge, near the center of the stream. The length of the chain from the end of the weight to the end of the last link is 28.01 feet. The gage is referred to bench marks as follows: (1) On the outer coping stone of the upstream wing wall of the right abutment, 0.2 foot each way from the edges meeting at the upstream corner; elevation, 27.59 feet above datum of gage. (2) The top surface of the hand rail at sounding point No. 80; elevation, 31.28 feet above datum of gage.

Discharge measurements of St. Marys River at Fort Wayne, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 20	Hanna and Clapp	120	600	2.27	5.59	1,361
May 26	M. S. Brennan	104	199	1.05	2.17	208
July 13	S. K. Clapp	105	254	.97	2.51	246
August 22	M. S. Brennan	104	173	.70	1.87	122
October 4	do	105	182	.73	1.92	133
December 7	do	113	516	.87	5.00	451

Daily gage height, in feet, of St. Marys River at Fort Wayne, Ind., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.1	2.65	1.7	1.42	1.04	1.3	1.55	1.32	3.4
2		2.6	2.15	1.7	1.41	1.04	1.24	1.55	1.3	3.0
3		2.0	1.8	1.7	1.4	1.04	1.2	1.7	1.3	3.1
4		1.6	1.7	1.68	1.39	1.04	1.12	1.95	1.3	4.06
5		1.3	2.4	3.25	1.38	1.04	1.1	2.1	1.37	4.35
6		1.1	2.0	2.17	1.36	1.04	1.08	2.0	1.5	5.57
7		1.0	1.9	3.35	1.35	1.2	1.07	1.94	1.58	5.2
8		.8	1.6	2.22	1.35	1.17	1.06	1.89	1.8	4.1
9		.6	1.65	2.0	1.45	1.14	1.06	1.84	2.2	2.85
10		.3	1.3	5.2	1.6	1.1	1.08	1.78	2.25	2.55
11			8.7	7.75	2.27	1.08	1.18	1.6	2.24	2.4
12				4.8	2.58	1.04	1.14	1.51	2.2	2.07
13				3.3	2.51	1.04	1.08	1.44	1.95	2.45
14				2.2	2.3	1.18	1.04	1.39	1.86	2.6
15				1.87	2.0	1.83	1.2	1.35	1.73	2.4
16				1.92	1.78	2.65	2.1	1.33	1.67	2.2
17				2.25	1.61	2.3	3.7	1.33	1.6	1.95
18				2.17	1.43	2.05	3.8	1.4	1.53	1.78
19				2.0	1.43	2.08	3.8	1.4	1.45	1.7

Daily gage height, in feet, of St. Marys River at Fort Wayne, Ind., for 1905—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
20	.....	1.75	.....	1.75	2.74	2.58	3.9	1.35	1.42	1.6[illegible]
21	3.5	6.1	.....	1.61	1.8	2.41	4.1	1.42	1.4	2.8
22	2.9	7.0	.....	1.8	1.45	1.88	4.4	1.52	1.38	3.2
23	2.5	5.6	.....	1.82	1.34	1.67	4.4	1.7	1.37	3.55
24	2.6	4.45	.....	1.73	1.25	1.62	4.1	1.61	1.36	3.8
25	2.1	3.9	.....	1.67	1.2	2.05	3.6	1.5	1.35	3.9
26	1.9	3.8	2.15	1.65	1.15	2.4	3.0	1.57	1.34	3.92
27	1.7	4.0	2.3	1.65	1.13	2.04	2.4	1.6	1.4	3.85
28	1.5	5.1	1.9	1.65	1.13	1.86	2.0	1.53	1.88	3.4
29	1.3	4.6	2.17	1.55	1.11	1.61	1.8	1.41	4.68	3.1
30	3.0	3.8	2.4	1.5	1.09	1.5	1.6	1.35	4.35	2.97
31	3.6	.....	1.84	.....	1.06	1.38	.....	1.34	.....	2.83

NOTE.—Ice gorge below the gage caused backwater December 4-8 and 13-16.

TIFFIN RIVER NEAR DEFIANCE, OHIO.

Tiffin River rises in southeastern Michigan, flows in a general southeasterly direction, and joins the Maumee at Defiance, 2 or 3 miles above the mouth of Auglaize River.

The gaging station was established May 19, 1903. It is located at the highway bridge on the new road to Evansport, one-half mile above the settlement of Brunnesburg and 3 miles by river above the center of the city of Defiance.

The channel at the station is somewhat curved, but the section is at right angles to the direction of the current. Both banks are high. The right bank is not liable to overflow, but the left will overflow at extreme high stages on account of a low place in the road. The bed of the stream is composed of gravel and rock, with deposits of silt at the sides of the channel. The velocity is sluggish at low stages at the regular section, but can be measured by wading a short distance below the bridge.

Discharge measurements are made from the single-span highway bridge, 140 feet long between abutments. The initial point for soundings is the face of the south abutment.

A standard chain gage, which was read during 1905 by F. A. Goddard, is located on the upstream hand rail of the bridge about 100 feet from the initial point for soundings. The length of the chain from the end of the weight to the marker is 28.00 feet. The bench mark is a cut on the upstream corner of the north abutment; elevation above gage datum, 23.82 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 423; 129, pp 71-72.
Discharge: 97, p 423; 129, p 72.
Discharge, monthly: 97, p 425; 129, p 73.
Gage heights: 97, p 424; 129, p 72.
Rating table: 97, p 424; 129, p 73.

Discharge measurements of Tiffin River near Defiance, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 25	M. S. Brennan	104	363	0.89	3.92	324
July 12	S. K. Clapp	115	585	1.51	5.70	882
October 27	R. W. Pratt	95	243	.35	2.70	84
November 22	do	92	227	.29	2.58	65

Daily gage height, in feet, of Tiffin River near Defiance, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	6.9	5.1	4.9	3.3	2.95	2.5	2.5	[a] 2.5	2.7	6.7
2	3.7	3.0	7.5	[a] 5.0	4.2	3.5	[a] 2.9	2.5	2.5	2.5	2.7	5.2
3	3.7	.....	7.7	5.0	4.0	3.3	2.9	2.5	[a] 2.4	2.5	2.7	[a] 5.0
4	3.6	.....	7.4	4.6	3.7	[a] 3.3	3.8	2.5	2.4	2.5	2.6	4.7
5	3.25	.....	[a] 7.4	4.2	3.7	3.3	3.5	2.5	2.4	2.5	[a] 2.6	4.5
6	3.15	.....	7.3	4.0	4.25	4.6	3.3	[a] 2.5	2.5	2.5	2.5	4.2
7	3.0	.....	7.2	3.8	[a] 4.6	7.1	3.8	2.5	2.5	2.5	2.7	3.8
8	.....	.....	7.2	3.6	5.0	8.4	4.0	2.4	2.5	[a] 2.5	2.5	3.7
9	3.0	.....	6.3	[a] 3.6	4.9	8.2	[a] 4.0	2.4	2.5	2.5	2.9	3.4
10	3.0	.....	6.3	3.5	4.5	7.9	4.0	2.4	[a] 2.5	2.5	3.1	[a] 3.3
11	3.0	3.2	6.8	3.5	14.0	[a] 9.6	6.0	2.4	2.5	2.5	3.0	3.2
12	3.0	.....	[a] 6.8	4.0	15.6	11.4	5.8	2.4	2.5	2.4	[a] 2.9	3.4
13	3.15	.....	6.7	5.2	17.4	10.3	5.4	[a] 2.4	2.5	2.5	2.8	3.4
14	3.25	.....	6.4	5.0	[a] 15.6	8.7	4.8	2.4	2.5	2.4	2.8	3.4
15	.....	.....	6.0	4.35	13.8	7.7	4.1	2.5	2.5	[a] 2.4	2.6	3.4
16	.....	.....	5.8	[a] 4.3	11.5	7.1	[a] 3.8	2.6	2.5	2.4	2.6	.....
17	.....	3.1	6.3	4.3	10.5	5.8	3.4	2.5	[a] 2.5	2.4	2.6	.....
18	.....	.....	7.1	4.1	9.5	[a] 5.0	3.1	2.5	2.5	2.4	2.6	.....
19	3.3	.....	[a] 7.7	3.8	8.3	4.3	2.9	2.5	2.8	2.4	[a] 2.6	.....
20	.....	.....	8.3	3.5	6.6	4.2	2.8	[a] 2.5	2.8	2.5	2.6	.....
21	3.4	.....	8.3	8.4	[a] 5.8	4.0	2.8	2.5	2.9	2.8	2.6	.....
22	.....	.....	8.3	10.8	5.0	4.5	2.7	2.5	2.9	[a] 3.2	2.6	.....
23	.....	.....	8.0	[a] 9.8	4.5	5.2	[a] 2.7	2.5	2.9	3.5	2.6	.....
24	.....	.....	7.7	8.8	4.2	5.2	2.7	3.5	[a] 2.7	3.2	2.6	.....
25	.....	3.35	7.4	7.7	3.9	[a] 4.7	2.5	3.0	2.5	3.0	2.6	.....
26	.....	.....	[a] 6.8	7.0	3.8	4.2	2.5	2.5	2.5	2.9	[a] 2.6	.....
27	3.3	4.9	6.2	6.5	3.5	3.4	2.5	[a] 2.5	2.5	2.8	2.5	.....
28	.....	5.8	5.5	5.8	[a] 3.4	3.2	2.5	2.5	2.5	2.8	2.7	.....
29	.....	.....	5.2	5.3	3.3	3.1	2.5	2.5	2.5	[a] 2.8	8.2	.....
30	.....	.....	5.0	.....	3.3	3.0	[a] 2.4	2.5	2.5	2.7	8.4	.....
31	.....	.....	5.9	.....	3.3	.....	2.4	2.5	.....	2.7	.....	.....

[a] Gage height interpolated.

NOTE.—River frozen entirely across January 1 to February 28. During the frozen period gage heights are to the water surface in a hole in the ice. The following comparative readings were also made.

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 7	3.0	3.1	0.4
January 14	3.25	3.25	.6
January 21	3.4	3.5	.7
January 27	3.3	3.4	.8
February 3	3.0	3.1	1.0
February 11	3.1	3.3	1.2
February 17	3.0	3.2	1.2
February 25	3.5	Water over ice.	.....

No ice record for December was made.

Station rating table for Tiffin River near Defiance, Ohio, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	36	4.80	588	7.20	1,392	10.20	2,584
2.50	52	4.90	619	7.30	1,428	10.40	2,669
2.60	69	5.00	650	7.40	1,465	10.60	2,755
2.70	86	5.10	681	7.50	1,502	10.80	2,842
2.80	104	5.20	712	7.60	1,539	11.00	2,930
2.90	122	5.30	743	7.70	1,576	11.20	3,018
3.00	140	5.40	775	7.80	1,614	11.40	3,107
3.10	159	5.50	807	7.90	1,652	11.60	3,197
3.20	178	5.60	839	8.00	1,690	11.80	3,288
3.30	198	5.70	871	8.10	1,729	12.00	3,380
3.40	219	5.80	904	8.20	1,768	12.20	3,474
3.50	240	5.90	937	8.30	1,807	12.40	3,570
3.60	262	6.00	970	8.40	1,847	12.60	3,668
3.70	285	6.10	1,004	8.50	1,887	12.80	3,766
3.80	309	6.20	1,038	8.60	1,927	13.00	3,864
3.90	334	6.30	1,072	8.70	1,967	13.50	4,110
4.00	360	6.40	1,107	8.80	2,008	14.00	4,360
4.10	387	6.50	1,142	8.90	2,049	14.50	4,611
4.20	414	6.60	1,177	9.00	2,090	15.00	4,866
4.30	442	6.70	1,212	9.20	2,172	15.50	5,121
4.40	470	6.80	1,248	9.40	2,254	16.00	5,380
4.50	499	6.90	1,284	9.60	2,336	16.50	5,645
4.60	528	7.00	1,320	9.80	2,418	17.00	5,914
4.70	558	7.10	1,356	10.00	2,500		

The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1903–1905. It is well defined between gage heights 2.3 feet and 5.7 feet. The table has been extended beyond these limits, being based on one measurement at 14 feet.

Estimated monthly discharge of Tiffin River near Defiance, Ohio, for 1905.

[Drainage area, 748 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	1,807	650	1,287	1.72	1.98
April	2,842	240	807	1.08	1.16
May	6,130	198	1,454	1.94	2.24
June	3,107	140	917	1.23	1.37
July	970	36	250	.334	.385
August	240	36	57.8	.077	.089
September	122	36	62.0	.083	.093
October	240	36	76.6	.102	.118
November	1,847	52	197	.263	.293
December 1–15	1,212	178	407	.544	.303

BLACK RIVER BASIN.

BLACK RIVER NEAR ELYRIA, OHIO.

The basin of Black River adjoins that of Vermillion River on the west and that of Rocky River on the east.

The gaging station was established May 23, 1903, the object being to furnish data for the water supply of near-by towns. It is located at the North Ridge Road Bridge, about 5 miles from the center of the city of Elyria.

The channel is straight for 300 feet above and 200 feet below the bridge, which consists of a single span 123 feet long. The right bank is fairly high and overflows only at extreme flood stages, a large field adjacent being generally flooded at the same time. The left bank is a rocky bluff, 75 to 100 feet high, which can not overflow. The current at the regular section is sluggish at low stages, but may be measured by wading 500 feet below.

Discharge measurements are made from the highway bridge. The initial point for soundings is the face of the west abutment.

The original gage consisted of an inclined 1 by 6 inch board, set on edge in the bank and secured to long stakes, and a vertical section nailed to stakes driven into the ground. A regulation chain gage, which was read during 1905 by N. L. Dunfee, has been installed to replace the rod gage. The length of the chain from the end of the weight to the marker is 24.67 feet. The gage is referred to bench marks as follows: (1) A nail in the root of a double tree which is in line with the center of and 38 feet west from the west end of the bridge; elevation above gage datum, 28.74 feet. (2) The top of the flange of the fifth floor beam from the west abutment, on the downstream end, almost under the pulley of the gage; elevation above gage datum, 22.56 feet. The elevation of the center of the pulley is 24.67 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 420–421; 129, p 74.
Discharge: 97, p 421; 129, p 74.
Discharge, monthly: 97, p 422.
Gage heights: 97, p 421; 129, p 75.
Rating table: 97, p 422.

Discharge measurements of Black River near Elyria, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 17	R. W. Pratt	75	119	0.96	2.80	114
February 1	do	39	41	.59	1.75	24
May 24	M. S. Brennan	69	52	1.09	1.44	56
October 20	R. W. Pratt	55	.....	.....	1.08	10
November 4	do	55	30	.40	1.15	12

CUYAHOGA RIVER BASIN.

CUYAHOGA RIVER AT INDEPENDENCE, OHIO.

Cuyahoga River rises in eastern Geauga County, flows south-southwestward to a point within about 2 miles of Akron, then turns sharply and flows northwestward to Lake Erie. Its course is extremely tortuous. In one place a straight line 5 miles long would touch two points 12 miles apart by the channel. The valley consists largely of a series of basins, the hills reaching 200 feet or more in height. Many lakes and swamps occur in the headwater region.

The gaging station was established September 21, 1903. It is located at the highway bridge at the town of Independence, 10 miles south of Cleveland and 4 miles south of the gaging station formerly located on the highway bridge between Brooklyn and Newberg, Ohio.

The channel is straight for 200 feet above and 400 feet below the station. Both banks are high and thinly wooded. The bed of the stream is of hard clay, covered with scattered stones about 1 inch in diameter. The current is sluggish at low water, but fairly swift at high stages.

Discharge measurements are made from the single-span iron-truss highway bridge to which the gage is attached. This bridge is 130 feet long. The initial point for soundings is the inner face of the eastern abutment.

A standard chain gage, which was read during 1905 by W. H. Rupp, is bolted to the hand rail of the bridge on the downstream side, 100 feet west of the initial point. The length of the chain from the end of the weight to the back of the ring is 26.84 feet. The gage is referred to bench marks as follows: (1) A cross cut on the northeast corner of the top stone of the north wing wall of the west abutment; elevation, 23.65 feet. (2) A cross cut on the southwest corner of the top stone of the south wing wall; elevation, 22.58 feet. (3) The top of the inside I-beam of the lower chord, downstream side, at a point 100 feet west of the initial point; elevation, 23.95 feet. Elevations are above the datum of the gage. The elevation of the center of the pulley is 26.18 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 418–419; 129, pp 75–76.
Discharge: 97, p 419; 129, p 76.
Discharge, monthly: 129, p. 78.
Gage heights: 97, p 419; 129, pp. 76–77.
Rating table: 129, pp 77–78.

Discharge measurements of Cuyahoga River at Independence, Ohio, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 23	M. S. Brennan	65	254	1.20	5.29	[illegible]
July 8	S. K. Clapp	87	238	1.11	5.05	[illegible]
October 7	R. W. Pratt	61	233	.94	5.10	[illegible]

Daily gage height, in feet, of Cuyahoga River at Independence, Ohio, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.25	5.6	7.7	5.2	5.2	5.65	5.1	5.4	5.0	.....	5.35	[illegible]
2	6.0	5.6	7.0	5.2	5.2	5.25	5.0	5.35	5.0	.....	5.35	[illegible]
3	5.7	5.6	7.0	5.15	5.1	5.05	5.05	5.3	5.0	.....	5.35	[illegible]
4	5.65	5.6	7.0	5.4	5.0	4.9	5.25	5.2	5.05	.....	5.3	[illegible]
5	5.6	5.6	7.6	5.25	5.1	4.85	5.05	5.1	5.1	.....	5.35	[illegible]
6	5.6	5.6	7.8	5.5	5.0	5.05	5.0	5.05	5.1	.....	6.15	[illegible]
7	5.6	5.6	8.8	5.45	4.85	6.2	5.0	5.05	5.0	.....	6.05	[illegible]
8	5.5	5.6	9.2	5.3	5.1	5.6	5.1	5.1	5.0	.....	6.2	[illegible]
9	5.3	5.6	11.9	5.2	5.0	5.35	4.9	5.0	4.95	5.15	6.3	[illegible]
10	6.0	5.6	11.8	4.9	5.05	5.35	4.8	4.9	4.9	5.1	6.2	[illegible]
11	6.1	5.6	10.0	5.5	5.15	5.6	5.0	5.05	5.2	5.1	6.1	[illegible]
12	5.1	5.6	9.8	6.75	12.6	5.55	5.2	5.4	6.0	5.2	6.0	[illegible]
13	7.0	5.6	9.0	6.5	8.8	5.45	6.0	5.5	5.8	5.2	6.05	[illegible]
14	6.8	5.6	8.2	5.9	7.5	5.4	6.3	5.4	5.6	5.2	5.9	[illegible]
15	6.7	5.6	7.2	5.9	7.6	5.45	8.2	6.4	5.35	5.55	5.9	[illegible]
16	6.7	5.6	6.5	5.9	7.2	8.6	5.8	6.6	6.0	5.5	6.0	[illegible]
17	6.7	5.6	7.8	5.95	7.2	7.65	5.3	6.3	6.1	5.5	6.0	[illegible]
18	6.7	5.6	9.2	6.0	7.2	6.1	5.2	6.2	6.6	5.55	5.8	[illegible]
19	5.85	5.6	17.3	5.75	6.4	6.15	5.15	5.5	6.3	6.0	5.8	[illegible]

Daily gage height, in feet, of Cuyahoga River at Independence, Ohio, for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
20	5.85	5.65	16.2	5.55	6.1	7.4	9.5	6.2	9.9	7.0	5.75	5.25
21	5.8	5.65	14.9	10.2	5.8	7.2	7.7	5.85	7.5	6.85	5.55	7.1
22	5.7	5.65	14.6	8.9	5.6	6.8	6.1	5.4	7.2	6.6	5.35	8.6
23	5.65	5.65	13.0	7.8	5.45	6.8	5.8	6.0	6.3	6.5	5.3	8.1
24	5.6	5.65	11.0	6.9	5.1	6.0	5.95	5.8	5.95	6.4	5.25	7.9
25	5.6	5.65	9.6	6.65	5.3	5.9	5.6	6.5	5.85	6.1	5.2	7.2
26	5.6	5.65	8.2	6.1	5.3	5.65	5.3	5.9	5.45	5.9	5.2	7.0
27	5.6	5.65	7.4	5.85	9.2	5.7	5.1	5.5	5.3	5.65	5.2	6.5
28	5.6	8.0	6.8	5.8	8.7	5.5	5.0	5.25	5.1	5.5	5.3	6.0
29	5.6	.....	6.25	5.5	7.0	5.45	5.1	5.2	5.1	5.3	10.2	6.05
30	5.6	.....	5.9	5.4	6.6	5.25	5.3	5.2	.....	5.2	9.9	5.9
31	5.6	.....	5.4	.....	6.2	.....	5.4	5.0	.....	5.3	.....	6.0

NOTE.—The river was frozen entirely across January 10 to February 28, approximately. March 1-10 ice was breaking up. Thickness of ice 1 foot to 1.4 feet. Gage heights are to the water surface in a hole cut in the ice. Most of the time the water was flush with the top of the ice.

Station rating table for Cuyahoga River at Independence, Ohio, from September 21, 1903, to August 23, 1904, and from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.40	56	6.20	623	8.00	1,350	10.60	2,624
4.50	82	6.30	660	8.10	1,394	10.80	2,734
4.60	109	6.40	698	8.20	1,439	11.00	2,845
4.70	137	6.50	736	8.30	1,484	11.20	2,959
4.80	166	6.60	774	8.40	1,530	11.40	3,077
4.90	195	6.70	812	8.50	1,576	11.60	3,197
5.00	225	6.80	852	8.60	1,622	11.80	3,221
5.10	255	6.90	892	8.70	1,668	12.00	3,445
5.20	286	7.00	932	8.80	1,715	12.20	3,573
5.30	317	7.10	972	8.90	1,762	12.40	3,701
5.40	349	7.20	1,012	9.00	1,809	12.60	3.830
5.50	381	7.30	1,053	9.20	1,903	12.80	3,960
5.60	414	7.40	1,094	9.40	1,999	13.00	4,090
5.70	447	7.50	1,136	9.60	2,096	13.20	4,222
5.80	481	7.60	1,178	9.80	2,196	13.40	4,356
5.90	515	7.70	1,220	10.00	2,300	13.60	4,492
6.00	550	7.80	1,263	10.20	2,408	13.80	4.630
6.10	586	7.90	1,306	10.40	2,516		

The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1903-1905. One flood measurement at gage height 14.65 feet serves to determine the upper part of the curve. It is well defined between gage heights 4.7 feet and 7.05 feet. Above gage height 13.7 the rating curve is a tangent, the difference being 70 per tenth.

Estimated monthly discharge of Cuyahoga River at Independence, Ohio, for 1905.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 1-9	642	317	445	0.638	0.2[illegible]
March 11-31	7,080	349	2,408	3.45	2.[illegible]
April	2,408	195	596	.854	.[illegible]
May	3,830	180	740	1.06	1.[illegible]
June	1,622	180	533	.764	.[illegible]
July	2,047	166	446	.639	.[illegible]
August	774	195	399	.572	.[illegible]
September 1-29	2,248	195	487	.698	.[illegible]
October 9-31	932	255	460	.659	.[illegible]
November	2,408	286	572	.819	.[illegible]
December	1,622	255	762	1.09	1.[illegible]

LAKE ONTARIO DRAINAGE.

GENERAL FEATURES.

In the northwestern part of the State of New York, between Niagara and St. Lawrence rivers, is an area aggregating 12,400 square miles drained by streams which flow into Lake Ontario. The divide which controls this drainage is very irregular. Extending to the south and southeast from Fort Niagara, it passes around the headwaters of the Genesee a short distance into Pennsylvania; thence reentering New York it runs southward and eastward from the interior group of lakes, turns to the north, encircles the sources of Black River, turns again to the west, and descends to the lake. The country thus included is level or gently undulating in the counties bordering the lake, but farther south it becomes more rolling, and a series of ridges, gradually increasing in height, stretch down between Cayuga and Seneca, and their companion lakes, finally becoming merged with the elevated, broken country forming the principal divide, the abrupt slopes of which attain altitudes of from 2,000 to 2,500 feet about the headwaters of the Genesee.

The easterly or Black River lobe of the drainage basin receives the run-off from the southwestern slope of the Adirondack Mountains—largely a rugged and forest-covered area, receiving heavy precipitation, especially in the winter.

Drift deposits are generally scattered over the section, and the soil is in part derived from that source and in part from the disintegration of native rocks.

The principal streams of the area are the Oswego, formed by the union of Seneca and Oneida rivers, which drain the chain of lakes in central New York, and Genesee, Salmon and Black rivers.

OAK ORCHARD CREEK BASIN.

OAK ORCHARD CREEK NEAR MEDINA, N. Y.

Oak Orchard Creek drains a swampy plateau, having an elevation of 600 to 650 feet above tide, and lying in an east-west direction south of Medina and Albion, N. Y. At the western border of this swamp the stream turns northward, crosses Erie Canal at Medina and enters Lake Ontario at Point Breeze.

The original Tonawanda Swamp had two outlets, the east end draining into Sandy Creek, near Holly, N. Y., and the west end being tributary to Tonawanda Creek. In 1824 a channel was cut across the west end of the Tonawanda Swamp to Oak Orchard Creek, the object being to divert a portion of the flow of Tonawanda Creek to feed the long level.

of Erie Canal extending from Lockport to Rochester. This feeder channel intercepts the drainage from a portion of Tonawanda Creek watershed, including Whitney Creek, a small tributary. The flow from the diverting dam on Tonawanda Creek into the feeder channel is controlled by gates and is cut off except during the season of canal navigation.

Water brought from lower Tonawanda Creek and from Lake Erie through the Erie Canal is passed over the waste wier at Medina, entering Oak Orchard Creek. The amount thus received by the watershed at times greatly exceeds that taken from Oak Orchard feeder for the supply of the canal. Hence the importance of the stream for water-power purposes is chiefly confined to its lower course, about 18 miles, from Medina to its mouth. In this distance occurs a fall of 250 feet. Throughout much of the distance the stream flows through a gulf cut in the drift overlying the Medina sandstone and affording a narrow flood plain.

A temporary gaging station was established on Oak Orchard Creek at Coon's bridge, which is located 6 miles from Medina along the stream and is just below the junction of Tonawanda feeder and the so-called Acker ditch, an artificial channel 2 miles long, leading Oak Orchard Creek into the lower end of the feeder channel.

The stream bends about 100 feet above the bridge, but is straight below, and the current passes normal to the bridge, which has a single span of 60.8 feet between vertical masonry abutments. The low-water flow is confined in a central channel about 25 feet in width, with hard, gravel bed and smooth, uniform current. This channel was excavated by the State of New York in 1894. The remaining channel unoccupied by the low-water course is covered with silt and sand and has numerous willow bushes. A secondary flood channel, having a width of 26 feet between abutments, is 283 feet to the right of the main bridge. Water also flows over a highway between the two bridges in extreme freshets.

A low-water gage, reading from zero to 4.5 feet, is attached vertically to a brace post underneath the downstream side of the bridge, at the right-hand side of the low-water channel.

Regular gage observations were not taken during 1905. The discharge measurements listed below were made at a highway bridge 1 mile below Coon's bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 412–415; 129, pp 79–80.
Discharge: 97, pp 415–416; 129, p 80.
Gage heights: 97, p 416; 129, p 81.

Discharge measurements of Oak Orchard Creek near Medina, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 25	Covert and Weeks	89	618	2.21	10.80	1,368
April 3	C. C. Covert	74	444	1.76	8.00	770

Station rating table for Oak Orchard Creek near Medina, N. Y., from May 17, 1903, to August 9, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	13	2.90	128	4.80	299	7.40	663
1.10	18	3.00	135	4.90	310	7.60	697
1.20	23	3.10	142	5.00	321	7.80	732
1.30	28	3.20	149	5.10	333	8.00	768
1.40	33	3.30	157	5.20	345	8.20	804
1.50	38	3.40	165	5.30	357	8.40	842
1.60	44	3.50	173	5.40	369	8.60	881
1.70	50	3.60	181	5.50	381	8.80	921
1.80	56	3.70	190	5.60	394	9.00	961
1.90	62	3.80	199	5.70	407	9.20	1,003
2.00	68	3.90	208	5.80	420	9.40	1,045
2.10	74	4.00	217	5.90	433	9.60	1,089
2.20	80	4.10	226	6.00	447	9.80	1,133
2.30	86	4.20	236	6.20	475	10.00	1,177
2.40	93	4.30	246	6.40	504	10.20	1,222
2.50	100	4.40	256	6.60	534	10.40	1,268
2.60	107	4.50	266	6.80	565	10.60	1,316
2.70	114	4.60	277	7.00	597	10.80	1,366
2.80	121	4.70	288	7.20	629	11.00	1,416

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1903–1905. It is not well defined.

Estimated monthly discharge of Oak Orchard Creek near Medina, N. Y., for 1903–4.

[Drainage area, 143 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
May 17–31	38	23	29.1	0.203	0.113
June	20	10	13.2	.092	.10[illegible]
July	53	17	26.1	.183	.21[illegible]
August	122	0	41.4	.290	.33[illegible]
September	68	24	43.3	.303	.33[illegible]
October	38	19	32.6	.228	.2[illegible]
November	51	24	33.7	.236	.2[illegible]
December	74	26	46.3	.324	.37[illegible]
1904.					
March 5–31	1,321	461	939	6.57	6.[illegible]
April	1,041	319	576	4.03	4.[illegible]
May	404	53	149	1.04	1.[illegible]
June	93	12	40.8	.285	.31[illegible]
July	56	11	29.5	.206	.23[illegible]
August 1–9	10	2	5.2	.036	.012

GENESEE RIVER BASIN.

DESCRIPTION OF BASIN.

Genesee River rises in Potter County, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles by general course, then turns to the northeast, and empties into Lake Ontario 7 miles north of Rochester. The entire length of the stream, following bends, is about 135 miles, and the drainage area is 2,496 square miles.

In the northern counties the surface is rolling, with long, easy slopes, except along the streams, which usually lie in deep ravines hemmed in by steep banks. On the whole there is a gradual rise away from the lakes, and in the upper half of the basin the country becomes rough and is broken by ridges, the summits of which attain elevations of from 2,000 to 2,500 feet above tide.

In the 39 miles between Belmont, in central Allegany County, and Portage, in southwestern Livingston County, the fall of the water surface is 253 feet, an average of 6.4 feet per mile. At Portage the river plunges down in three magnificent falls, and thence nearly to Mount Morris flows at the bottom of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows subject to occasional overflow. At Rochester there is another abrupt descent over three heavy falls, amounting to about 260 feet within the city.

The series of remarkable lakes tributary to the Oswego basin is continued westward into the basin of the Genesee and includes Conesus, Hemlock, Canadice, and Honeoye lakes. These lakes serve as natural reservoirs and have inlets draining considerable areas at their upper ends. The slopes adjacent to the lakes themselves are narrow and steep and are drained by gulleys and torrential brooks. The area below the lakes is rolling and the soil is rich and extensively cultivated. The areas and elevations of these lakes are shown in the following table:

Areas and elevations of lakes in Genesee River basin.[a]

Lake.	Elevation.	Water-surface area.	Drainage area.	Per cent water surface.
	Feet.	*Sq. miles.*	*Sq. miles.*	
Hemlock Lake	896	2.8	46.8	6.12
Canadice Lake	1,092	.7	12.6	5.57
Honeoye Lake	800	2.5	39.6	6.41

[a] These lake basins are shown on the Honeoye, Canandaigua, Naples, and Wayland topographic atlas sheets of the United States Geological Survey, from which the areas have been taken, with the exception of those for Hemlock and Canadice lakes, which are from surveys of Rochester waterworks.

Above all the private dams at Rochester the State has a dam for diverting water to the Erie Canal, and in the basin of Black Creek, one of the upper tributaries of the Genesee from the west, are two reservoirs, owned by the State, also used for the benefit of the Erie Canal.

Cuba reservoir, on the Genesee-Allegheny divide, receives the drainage from a tributary area of 26.6 square miles. The storage volume is 454,000,000 cubic feet. The overflow from this reservoir enters Allegheny River. The storage water may be turned into the summit level of the abandoned Genesee Valley Canal and thence into Genesee River.

GENESEE RIVER AND CANASERAGA CREEK NEAR MOUNT MORRIS, N. Y.

This station was established May 22, 1903. It is located at the highway bridge near Mount Morris, a short distance below the inflow of Canaseraga Creek.[a]

About 300 feet above the bridge the channel bends abruptly, but it is straight for several hundred feet below the gage. The bed of the stream is of clay. During flood stages both banks are overflowed and the discharge can not be determined at this station.

[a] The location of the gaging station and the course of the river from Jones Bridge to its outlet into Lake Ontario near Rochester is shown on the Caledonia, Honeoye, and Rochester topographic atlas sheets of the United States Geological Survey.

Discharge measurements are made from a footbridge erected on the outriggers of the downstream side of the highway bridge, which consists of two spans of 174.3 and 31.7 feet, respectively. The initial point for soundings is the top of the face of the left abutment, downstream side. Measurements of Canaseraga Creek are also made from a bench-mark station near the mouth of the stream.

A standard chain gage, which is read twice daily by J. T. Trewer, is secured to the truss uprights near the center of the main bridge span on the upstream side. The length of the chain is 15.50 feet. The bench mark is the corner of the wing wall, left abutment, upstream side; elevation, 30.36 feet above datum plane of gage.

A temporary gaging station has also been established at the dam of the Mount Morris Water Power Company, in the village of Mount Morris. The dam is of masonry, having a horizontal crest of ogee cross section, suitable for accurate determination of discharge. A gage has been placed in the pond above the dam and observations were taken during the spring freshet of 1905 and also from September 1 to the end of the year. A portion of the flow is diverted through a section of the Genesee Valley Canal, which is utilized as a head-race, the power being used to drive a number of mills and factories. In order to determine the amount of this diversion a gage has been placed in the tailrace below the mills and a number of current-meter measurements have been made, as listed below.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 262-264; WS 97, p 411; 129, p 81-82.
Discharge: WS 97, p 411; 129, p 82.
Discharge, monthly: Ann 20, iv, pp 225-226.
Discharge, yearly: Ann 20, iv, p 52.
Gage heights: WS 97, p 412; 129, pp 82-83.
Hydrographs: Ann 19, iv, p 263; 20, iv, p 227.

Discharge measurements of Genesee River near Mount Morris, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 23 [a]	Covert and Weeks	177	3,581	3.56	23.68	11,0[illegible]
March 22 [a]	do	177	3,296	3.30	23.40	10,[illegible]
March 24 [a]	do	203	3,786	4.04	24.90	15,[illegible]
March 30	do	198	2,196	4.44	17.07	9,3[illegible]
March 30	do	174	2,070	4.42	16.80	9,1[illegible]
March 31	do	168	1,644	4.40	14.12	7,2[illegible]
April 1	do	165	1,285	4.05	11.78	5,2[illegible]
August 25	C. C. Covert	75	223	1.22	4.28	272

[a] Pondage on flats below, causing backwater at gaging station.

Daily gage height, in feet, of Genesee River near Mount Morris, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.65	8.2	6.7	11.45	6.25	4.62	5.15	8.69	4.35	3.85	4.7	7.35
2	8.7	8.15	6.55	9.9	6.0	4.62	5.05	7.59	4.5	4.05	5.1	6.25
3	9.05	7.9	6.45	8.85	5.95	4.57	5.05	6.69	4.3	4.2	5.15	7.35
4	8.25	7.8	6.4	8.15	5.7	4.42	5.1	6.04	4.3	4.3	5.05	10.3
5	9.55	7.5	6.35	8.4	5.6	4.37	5.0	5.59	4.2	4.3	5.05	8.2
6	10.55	7.6	6.25	8.45	5.55	5.47	4.95	5.19	4.25	4.3	5.2	7.45
7	12.0	7.6	6.35	8.2	5.65	6.77	4.85	5.04	4.2	4.1	6.95	7.0
8	12.0	7.5	6.35	7.9	5.9	7.76	4.85	5.04	4.2	4.0	6.3	6.95
9	11.65	7.35	6.4	7.45	5.65	6.56	4.75	4.89	4.2	3.95	6.3	7.2
10	11.3	7.4	6.65	7.05	5.4	5.71	4.75	4.99	4.0	3.95	5.95	7.3
11	11.05	7.4	6.75	7.35	5.4	5.51	4.65	4.99	4.15	3.95	5.6	6.8

Daily gage height, in feet, of Genesee River near Mount Morris, N. Y., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
12	11.0	7.15	7.0	9.1	5.35	6.31	5.95	5.59	4.6	4.0	5.6	6.1
13	11.25	7.1	6.9	8.4	5.3	5.76	5.95	5.68	5.5	4.2	5.5	5.95
14	12.0	7.1	6.85	7.6	5.2	5.41	7.7	5.38	5.15	4.55	5.3	5.8
15	12.35	6.95	6.6	7.3	5.2	5.16	7.35	5.18	4.85	4.65	5.2	5.2
16	11.35	6.85	6.65	7.45	5.15	4.96	6.35	5.08	4.75	4.5	5.1	5.55
17	10.6	6.65	6.8	7.55	5.12	5.21	5.7	5.08	5.2	4.3	5.15	6.15
18	10.55	6.7	7.9	7.45	5.02	8.71	5.25	4.93	5.4	4.2	5.2	6.2
19	10.45	6.5	.....	7.45	5.02	7.91	5.1	4.73	4.85	4.2	5.15	6.3
20	10.3	6.4	.....	7.6	5.02	7.46	5.2	4.58	4.6	5.65	5.1	5.3
21	10.1	6.45	.....	15.75	4.87	7.76	5.0	4.43	4.5	5.65	4.9	5.45
22	9.85	6.5	.....	17.95	4.82	13.81	4.84	4.43	4.45	5.4	4.85	14.2
23	9.5	6.65	23.55	11.9	4.77	11.26	4.64	4.38	4.3	5.25	4.7	10.65
24	9.35	6.65	24.7	9.7	4.77	8.71	5.04	4.28	4.1	5.55	4.65	8.6
25	9.1	6.6	24.2	8.55	4.72	7.41	4.99	4.26	4.15	5.25	4.75	7.5
26	8.85	6.8	24.75	7.8	4.67	6.61	4.99	4.15	4.05	5.15	4.8	6.7
27	8.5	6.8	24.7	7.2	4.77	6.11	4.69	4.1	4.1	5.0	4.8	6.45
28	8.6	6.7	23.6	6.8	4.72	5.86	4.64	4.0	4.05	4.85	4.7	6.2
29	8.55	.....	20.4	6.5	4.72	5.51	7.84	4.1	4.0	4.75	6.5	9.1
30	8.45	.....	16.8	6.4	4.67	5.3	9.84	4.1	4.05	4.65	12.15	14.4
31	8.3	.....	13.8	.....	4.72	.....	8.84	4.35	.....	4.6	.....	9.7

NOTE.—River frozen entirely across January 1 to March 31, approximately. Thickness of ice 1 to 1.4 feet. Gage heights are to the water surface in a hole in the ice.

Station rating table for Genesee River near Mount Morris, N. Y., from May 22, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	180	6.30	1,092	8.60	2,458	12.80	5,656
4.10	201	6.40	1,146	8.70	2,526	13.00	5,820
4.20	225	6.50	1,200	8.80	2,594	13.20	5,984
4.30	251	6.60	1,254	8.90	2,662	13.40	6,148
4.40	279	6.70	1,308	9.00	2,730	13.60	6,314
4.50	310	6.80	1,362	9.20	2,868	13.80	6,482
4.60	344	6.90	1,416	9.40	3,008	14.00	6,650
4.70	380	7.00	1,470	9.60	3,152	14.20	6,818
4.80	418	7.10	1,524	9.80	3,300	14.40	6,986
4.90	458	7.20	1,579	10.00	3,450	14.60	7,154
5.00	500	7.30	1,635	10.20	3,602	14.80	7,322
5.10	544	7.40	1,692	10.40	3,754	15.00	7,490
5.20	588	7.50	1,750	10.60	3,908	15.20	7,662
5.30	632	7.60	1,810	10.80	4,064	15.40	7,834
5.40	676	7.70	1,872	11.00	4,220	15.60	8,008
5.50	720	7.80	1,934	11.20	4,376	15.80	8,184
5.60	764	7.90	1,996	11.40	4,532	16.00	8,360
5.70	808	8.00	2,060	11.60	4,690	16.20	8,536
5.80	852	8.10	2,124	11.80	4,850	16.40	8,712
5.90	896	8.20	2,190	12.00	5,010	16.60	8,890
6.00	942	8.30	2,256	12.20	5,170	16.80	9,070
6.10	990	8.40	2,322	12.40	5,330	17.00	9,250
6.20	1,040	8.50	2,390	12.60	5,492		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is not very well defined. Above gage height, 17 feet, there is liability of backwater at this station; hence no estimate have been made for gage heights above that stage.

Estimated monthly discharge of Genesee River near Mount Morris, N. Y., for 1903–1905.

[Drainage area, 1,070 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
May 22-31	418	327	370	0.346	0.129
June	1,996	265	626	.585	.653
July	919	317	476	.445	.515
August	8,422	184	1,208	1.13	1.30
September	2,778	285	757	.707	.789
October	6,247	317	982	.918	1.06
November	6,835	351	1,061	.992	1.11
December	1,853	369	1,006	.940	1.08
1904.					
January (28 days)	8,422	952	2,264	2.12	2.21
February (22 days)	9,043	3,022	4,983	4.66	3.87
March (15 days)	9,205	4,376	6,240	5.83	3.25
April (28 days)	7,028	2,190	4,245	3.97	4.13
May	5,738	808	2,029	1.90	2.19
June	6,986	327	1,229	1.15	1.28
July	1,965	294	735	.687	.792
August	698	184	323	.302	.348
September	658	172	267	.250	.279
October	1,996	251	704	.658	.759
November	475	180	308	.288	.321
December (30 days)	4,142	190	939	.878	.980
1905.					
April (29 days)	8,140	1,146	2,405	2.25	2.53
May	1,066	369	598	.559	.644
June	6,490	271	1,346	1.26	1.41
July	3,330	358	828	.774	.892
August	2,519	180	583	.545	.628
September	720	180	311	.291	.325
October	786	150	359	.336	.387
November	5,130	362	784	.733	.818
December	6,986	588	1,921	1.80	2.08

NOTE.—On the omitted days of January, February, March, April, and December, 1904, and April 22, 1905, the gage height was greater than 17 feet. No estimates were made for these days on account of probable backwater.

Discharge measurements of Canaseraga Creek near Mount Morris, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 24 [a]	Covert and Weeks	100	1,446	1.47	6.12	2,011
March 30	do	100	772	3.72		2,877
March 31	do	90	546	3.87	15.12	2,115
April 1	do	82	374	3.86		1,444
August 25	C. C. Covert	60	92	2.73	21.28	252

[a] Backwater from Genesee River.

Discharge measurements of tailrace of Mount Morris power canal near Mount Morris, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 30	Covert and Weeks	34	106	2.32	2.62	245
March 31	do	34	102	2.22	2.35	221
March 31	do	33	95	2.06	2.11	189
August 24	C. C. Covert	36	85	1.91	2.08	158

GENESEE RIVER AT ROCHESTER, N. Y.

This station was established February 9, 1904. It is located at the Elmwood Avenue Bridge, in Rochester, N. Y.

The stream bed is of gravel and is clean and fairly permanent. The bridge consists of six spans of about 125 feet each. Conditions are favorable for the use of a current meter. This gage is located above the State diverting dam, which causes, however, but little fluctuation in the level.

Discharge measurements are made from the downstream side of Elmwood Avenue Bridge. The initial point for soundings is the top of the face of the left abutment, downstream side. A standard cypress staff gage, which has been read during 1905 under the direction of E. A. Fisher, city engineer, is secured to the downstream face of the first pier from the right-hand abutment of the bridge. The gage is 16 feet long and is graduated decimally with galvanized-iron division marks.

During the low-water seasons of 1903 and 1904 a series of current-meter measurements were made in the Carroll & Fitzhugh and the Johnson & Seymour race ways, which receive their water supply from the Johnson & Seymour dam on the Genesee in Rochester. This dam is located below the point of diversion from Genesee River to the Erie Canal feeder, and the pond above the dam receives only the supply available beyond that used by the extensive development at the three falls on the river which occur within the city limits. The dam is of masonry and is practically water-tight. An accurate profile of the crest of the dam has been obtained.

Measurements were taken both in the daytime and at night, in order to determine the relative day and night use of the water for power purposes. The water being drawn down to the minimum stage, the measurements represent, as nearly as possible, the natural low-water flow of the stream at this point.

Gage readings have been taken by the engineer department of the city of Rochester for a number of years, and the data have been used in computing the full discharge of the river.

The information furnished by the measurements at the dam will serve to extend the rating curve at Elmwood Avenue Bridge. The record at that point will, on the other hand, afford a basis for estimating the diversion of the two large power canals adjacent to the Johnson & Seymour dam.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 139-140; 97, p 398; 129, pp 83-84.
Discharge: 97, p 399; 129, p 84.
Discharge, flood: 65, p 141; 97, pp 400-403.
Elevation of water surface: WS 65, pp 141-142; 129, p 85.

Discharge measurements of Genesee River at Rochester, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 22	Covert and Weeks	382	4,222	5.87	10.00	24,710
March 22	do	382	4,202	5.92	9.95	24,860
March 25	do	382	4,304	5.92	10.20	25,480
March 27	do	382	4,199	6.00	9.92	25,190
March 27	do	382	4,164	5.94	9.82	24,750
March 28	do	382	4,046	5.82	9.50	23,550
March 29	do	382	3,959	5.69	9.08	22,530
April 2	do	373	2,136	3.06	4.18	6,530
April 3	do	372	1,891	2.75	3.50	5,197
April 4	do	372	1,819	2.52	3.28	4,576
May 28	C. C. Covert	352	974	.45	1.11	441

Daily gage height, in feet, of Genesee River at Rochester, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8			5.2	2.3	1.8	1.6	3.1	1.3	1.0	1.3	3.7
2	2.9			4.2	2.2	1.6	1.6	3.0	1.3	1.0	1.35	2.4
3	3.1			3.6	2.2	1.6	1.6	2.7	1.3	1.0	1.4	2.0
4	3.4			3.2	2.0	1.6	1.6	2.3	1.25	1.0	1.5	3.1
5	2.3			3.0	1.9	1.5	1.6	2.0	1.2	1.0	1.5	3.6
6	2.8			3.1	1.9	2.0	1.6	1.8	1.15	1.0	1.4	2.7
7	2.2			3.0	1.9	2.5	1.5	1.7	1.1	1.0	1.5	2.4
8	2.1			3.0	2.0	3.0	1.5	1.6	1.2	1.0	2.2	2.3
9	2.0			2.7	2.0	3.5	1.4	1.5	1.2	1.0	2.0	2.3
10	2.0			2.5	2.0	2.6	1.4	1.8	1.1	1.0	1.95	2.0
11	2.0			2.5	1.9	2.3	1.35	1.8	1.0	1.0	1.9	2.4
12	2.0			3.0	1.8	2.1	1.4	1.8	1.1	1.0	1.7	2.2
13	2.8			3.0	1.8	2.5	1.9	1.8	1.1	1.0	1.7	2.0
14	2.0			2.9	1.9	2.1	2.1	1.9	1.3	1.0	1.6	1.9
15	3.4			2.7	2.0	1.9	2.9	1.7	1.5	1.1	1.5	1.8
16	3.9			2.5	2.0	1.7	2.6	1.8	1.4	1.2	1.5	2.0
17	3.8	2.2		2.6	1.9	1.6	2.2	1.8	1.3	1.2	1.5	1.5
18	3.2		2.2	2.6	1.8	3.0	1.9	1.7	1.4	1.2	1.5	1.4
19	2.8		7.7	2.6	1.8	3.8	1.8	1.6	1.5	1.2	1.5	1.3
20	2.6		7.1	2.7	1.8	3.4	1.6	1.5	1.3	1.2	1.5	1.2
21	2.5		9.45	3.6	1.8	3.0	1.6	1.5	1.3	1.5	1.4	1.5
22	2.5		10.0	6.6	1.8	3.5	1.6	1.3	1.2	1.6	1.35	2.0
23	2.4		9.75	5.5	1.8	4.7	1.5	1.2	1.2	1.6	1.3	4.6
24	2.4		9.9	3.9	1.8	3.9	1.4	1.2	1.3	1.55	1.25	3.4
25	2.4		10.2	3.2	1.8	3.1	1.4	1.2	1.0	1.5	1.2	3.1
26	2.3		10.2	3.0	1.8	2.6	1.4	1.2	1.0	1.5	1.2	2.8
27	2.2		9.9	2.8	1.8	2.4	1.4	1.2	1.0	1.5	1.25	2.6
28			9.5	2.6	1.8	2.2	1.4	1.2	1.0	1.4	3.5	2.4
29			9.0	2.5	1.8	2.0	1.4	1.15	1.0	1.3	4.8	2.2
30			8.15	2.4	1.8	1.9	3.3	1.2	1.0	1.5	3.5	4.0
31			6.4		1.8		3.4	1.2		1.3		4.3

NOTE.—River frozen January 28 to March 20.

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

Canadice Lake is tributary to Genesee River through Hemlock Lake outlet and Honeoye Creek.[a] The area drained by the lake forms an irregular rectangle, the lake lying somewhat to the left of the longitudinal axis and the greater portion of the drainage being on the eastern slope. The western slope is narrow and precipitous. Bald Hill rises from an altitude of 1,090 feet at the lake to 1,800 feet at the summit and has its axis parallel to the lake at an average distance of three-fourths of a mile from it. The lake has a water surface area of 0.7 square mile and drains a total area of 12.6 square miles, 5.6 per cent of which is lake surface.

A weir was constructed at the outlet at the foot of the lake by the city engineer's department of Rochester, N. Y., in February, 1903. The entire yield of the drainage basin passes this weir.

A standard thin-edged weir, with a 5-foot crest and two end contractions, is so arranged with needle timbers at the ends that during high water the length may be increased to 14.96 feet with no end contractions. The weir crest stands 3 feet above the stream channel and is never submerged by backwater. There are two additional rectangular gates, each 1 foot square, with three complete contractions and a fourth partial contraction at the bottom. The outflow from the lake above the weir is controlled by gates.

A reading of the depth on the weir is taken each morning, and also for each change of the gates, the depth being read to hundredths and corrections being made for velocity of approach for the larger discharges. The discharge is calculated by the Francis formula. The record has been furnished by E. A. Fisher, city engineer, and John F. Skinner, principal assistant city engineer, of Rochester, N. Y.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 404-406; 129, p 86.
Discharge: 97, pp 407-409.
Discharge, monthly: 129, p 87.
Diversions: 97, p 410.
Gage heights: 97, p 409.

Estimated monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for 1904-5.

[Drainage area, 12.6 square miles.]

Month.	Mean discharge in second-feet.	Mean elevation of lake above low water, in feet.	Run-off.	
			Second-feet per square mile.	Depth in inches.
1904.				
January	8.70	1.42	0.690	0.796
February	26.51	2.38	2.10	2.27
March	40.85	2.90	3.24	3.74
April	32.46	2.69	2.58	2.88
May	25.27	3.15	2.01	2.32
June	17.19	2.79	1.36	1.52
July	9.72	2.43	.772	.888
August	8.35	1.90	.663	.764
September	6.06	1.22	.481	.537
October	5.04	.65	.400	.460
November	2.84	.15	.225	.251
December	3.97	—0.24	.315	.362
The year	15.58	1.79	1.24	16.79

[a] This drainage basin is shown on the Honeoye and Wayland topographic atlas sheets of the United States Geological Survey.

Estimated monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for 1904-5—Continued.

Month.	Mean discharge in second-feet.	Mean elevation of lake above low water, in feet.	Run-off.	
			Second-feet per square mile.	Depth in inches.
1905.				
January	12.2	.297	.968	1.12
February	5.5	.044	.437	[illegible]
March	13.2	.670	1.44	[illegible]
April	21.8	2.055	1.73	[illegible]
May	11.2	1.942	.889	[illegible]
June	16.8	2.573	1.33	[illegible]
July	19.7	2.806	1.56	[illegible]
August	18.0	2.386	1.43	[illegible]
September	7.5	1.578	.596	[illegible]
October	6.1	.926	.484	[illegible]
November	5.2	.464	.413	[illegible]
December	6.1	.509	.484	[illegible]
The year	12.36	1.354	.980	13.[illegible]

HONEOYE CREEK AT EAST RUSH, N. Y.

Honeoye Creek, the outlet of Honeoye Lake, enters Genesee River at Genesee Valley Junction. Four miles below its source it is joined by the combined outlet of Hemlock and Canadice lakes. The drainage area of the creek, approximately rectangular in form, is about 30 miles long and has an average width of 9.5 miles. The fall of 280 feet in the course of the stream has been largely used in the construction of dams. The diversion from Hemlock Lake by the city of Rochester is to be added to the measured run-off at East Rush to obtain the total yield of the drainage basin. The average diversion rate is about 22 second-feet.

The gaging station was established February 13, 1903. It is located at the gristmill dam in the village of East Rush.

The dam is of timber, and its crest, 150.15 feet long, varies somewhat in level. The record includes the flow over the dam and the discharge through two Leffel standard turbines, one 48 inches and the other 35 inches in diameter. Record is also kept of the head on the turbines, the number of hours each runs per day, and the average gate opening. This last is obtained by noting the number of gear teeth out of the total possible number through which the wheel-gate stems may be turned to open the gates, allowance being made for lost motion. The bench mark is on the window sill near the flume. Its elevation is 5.145 feet above the datum of the crest gage and 12.62 feet above the datum of the tailrace gage, the difference between the datums of the two gages being, therefore, 7.475 feet.

During 1905 the dam was repaired, and the discharge subsequent to September 30, 1905, has been calculated from a profile and survey made after these repairs were completed.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 403-404; 129, pp 87-88.
Discharge, mean daily: 129, pp 89-90.
Discharge, monthly: 129, p 90.

Daily discharge, in second-feet, of Honeoye Creek at East Rush, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	43	45	41	96	29	20	20	103	52	15	35	45
2	83	62	39	67	25	20	15	107	52	39	50	44
3	53	61	41	62	25	28	15	70	12	39	41	43
4	41	41	41	47	20	15	15	69	52	40	39	55
5	42	15	15	64	22	37	15	69	48	39	43	42
6	53	41	42	58	32	58	20	16	52	39	41	61
7	53	40	41	61	15	68	25	42	52	39	53	87
8	16	41	42	64	24	60	20	39	47	15	61	101
9	41	41	42	26	43	74	15	39	34	39	61	165
10	41	55	42	42	43	39	20	42	26	39	61	169
11	41	41	42	42	28	16	15	70	52	39	45	77
12	41	15	15	64	24	39	28	41	40	58	43	87
13	41	42	77	64	24	19	25	16	56	61	45	87
14	42	36	77	44	15	16	62	75	56	44	49	61
15	14	31	77	42	25	26	59	67	46	43	37	35
16	53	28	77	16	20	31	37	99	42	42	46	42
17	42	36	77	42	23	41	21	53	15	39	40	25
18	42	36	82	42	26	155	29	54	39	42	50	42
19	42	15	2,705	42	34	324	15	39	21	42	43	42
20	88	38	1,290	42	31	180	15	15	42	53	33	58
21	98	39	494	130	15	112	45	53	76	43	37	124
22	15	60	288	345	40	232	37	53	75	57	37	283
23	79	66	1,265	89	42	113	15	53	66	41	37	321
24	66	30	1,265	626	42	71	20	53	49	44	29	121
25	41	41	785	568	42	37	15	53	73	41	43	96
26	40	15	473	366	42	51	24	53	34	30	25	85
27	40	41	388	366	21	39	40	15	52	37	42	85
28	40	41	274	216	15	39	42	53	52	36	42	85
29	16	.....	216	262	22	30	42	53	45	43	34	124
30	40	.....	163	162	15	18	37	53	42	33	57	222
31	38	.....	213	.....	26	.....	42	53	.....	31	.....	219

Estimated monthly discharge of Honeoye Creek at East Rush, N. Y., for 1905.

[Drainage area, 238 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	98	14	46	0.193	0.222
February	66	15	39	.164	.171
March	2,705	15	346	1.45	1.67
April	626	16	138	.580	.647
May	43	15	27	.113	.130
June	324	15	67	.281	.314
July	62	15	27	.113	.130
August	107	15	54	.227	.262
September	76	12	47	.197	.220
October	61	15	40	.168	.194
November	61	25	43	.181	.202
December	321	25	101	.424	.489
The year	2,705	14	81	.341	4.65

OSWEGO RIVER BASIN.

DESCRIPTION OF BASIN.

Oswego River is formed by the union of Seneca and Oneida rivers about 12 miles northwest of Syracuse, N. Y., whence its course is northwestward to Oswego, where it enters Lake Ontario. The length of the river from the junction to the mouth is about 20.5 miles, and the drainage basin along this distance is a narrow strip of country, moderately rolling. Above the junction of Seneca and Oneida rivers the basin spreads out, attaining an extreme width east and west of about 100 miles and north and south of from 70 to 80 miles. There is, on the whole, a gradual rise from the low, level lands which border Lake Ontario to the north-south ridges which separate the various lakes south of Seneca River and which farther south become merged with the still more elevated country lying along the southern boundary of the Lake Ontario watershed.

The most remarkable feature of the drainage basin is the chain of lakes stretching across its southern border. From west to east the principal lakes are, in order, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Oneida. These seven lakes include a water surface of approximately 280 square miles, increased by four smaller lakes—Cross, Onondaga, Otisco, and Cazenovia—to about 295 square miles. The larger of the lakes, Oneida, Cayuga, and Seneca, are used for steam-towing navigation, having connection with the Erie and Oswego canals. Cayuga and Seneca lakes are noted for their depth and for the abrupt slopes of their beds. The influence of the lakes on Oswego River is of the utmost importance in contributing to the steadiness of its flow.

A fall of 100 feet in the course of the main river is largely utilized by seven dams, which also partly canalize the stream. The intervening stretches are covered by the Oswego Canal, which draws its water supply from the river.

OSWEGO RIVER AT BATTLE ISLAND, N. Y.

Oswego River is formed by the confluence of Oneida and Seneca rivers at Three River Point. The stream is shown throughout its course of 24 miles on the Oswego Special and Baldwinsville topographic atlas sheets of the United States Geological Survey. The drainage into the river below the junction of Oneida and Seneca rivers is of small extent and the tributaries are neither large nor numerous, receiving the drainage from a number of small lakes and marshes in a moderately rolling basin. Oneida and Seneca rivers are both notable for the large extent of lake and marsh area contained within their basins, Oneida Lake in the former and the Finger Lakes tributary to the latter stream affording extensive natural storage regulation of flow to Oswego River. The accompanying tables of discharge show the actual flow past the gaging station, not including the flow in Oswego canal.

This station was established September 14, 1900. It is 3 miles above the mouth of the river and 0.6 mile below the State dam at Battle Island. The discharge measurements from which the rating table has been deduced were made from a cableway crossing the stream 2,900 feet below the gage. The bed of the stream is of rock, and the current is smooth.

The stream is paralleled at the gaging station by the Oswego Canal, through which a small amount of diversion takes place.

A board gage in two sections is used. The bench mark is the top of a wire spike driven in a shelf cut in the base of a chestnut tree 300 feet northwest of the gage. Its elevation is 17.35 feet above gage datum. Gage readings have been taken twice each day during 1905 by Miss May Parmley.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 134; 82, p 72; 97, p 378; 129, pp 93-94.
Discharge: 47, p 39; 65, p 136; 82, p 76; 97, p 378; 129, p 94.
Discharge, daily: 82, pp 72-74; 97, p 380.
Discharge, monthly: 82, p 75; 97, p 381; 129, p 95.
Gage heights: 65, pp 134, 135; 97, p 379; 129, p 94.
Rating table: 129, p 95.

Daily gage height, in feet, of Oswego River at Battle Island, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.65	3.2	3.1	10.65	6.9	3.7	6.5	3.85	3.45	1.69	4.42	4.62
2	5.92	3.2	3.1	10.55	6.8	3.65	5.4	3.8	3.48	3.4	4.45	4.58
3	5.6	3.2	3.0	10.4	6.9	3.53	6.75	3.68	4.3	3.35	4.45	5.8
4	6.2	3.05	2.95	10.5	6.7	−.08	6.65	3.6	4.4	3.35	4.42	5.65
5	5.5	3.52	2.7	10.5	6.8	3.88	6.55	3.65	4.4	3.3	5.15	5.65
6	5.5	3.25	3.05	10.5	6.65	4.05	6.6	3.38	4.45	3.28	5.25	5.5
7	5.5	3.25	2.95	10.5	5.95	3.92	5.6	3.92	4.42	3.12	4.95	5.6
8	5.3	3.25	2.9	10.45	6.0	3.9	5.4	3.9	4.42	−.25	4.95	5.55
9	5.8	3.4	2.9	10.1	5.95	3.85	5.2	3.8	4.4	3.3	5.0	5.5
10	5.75	3.4	2.85	10.1	5.78	3.72	5.4	3.78	3.55	3.25	5.0	5.05
11	5.75	3.3	2.85	9.95	5.5	3.3	5.45	3.65	4.25	3.25	4.98	5.4
12	5.88	3.2	2.6	9.95	5.5	4.05	5.55	3.55	4.25	3.72	4.05	5.35
13	5.7	3.65	2.9	9.8	4.75	3.98	5.35	3.45	4.35	3.8	5.0	5.3
14	5.7	3.5	2.9	9.6	5.2	3.9	5.0	3.9	4.32	3.9	4.95	5.35
15	5.75	3.5	2.9	9.5	5.52	3.88	4.9	3.8	4.28	3.22	4.92	5.2
16	5.4	3.5	2.8	9.15	5.3	3.82	4.5	3.78	4.12	3.4	4.92	5.2
17	5.75	3.5	2.9	8.95	5.35	3.65	4.95	3.72	3.45	3.35	4.9	5.35
18	5.72	3.45	2.9	8.75	5.2	4.78	4.85	3.68	3.75	3.35	4.88	6.05
19	5.78	2.9	3.2	8.75	5.15	5.7	4.8	3.68	3.7	3.3	4.22	6.0
20	5.7	3.5	6.4	8.65	5.1	5.6	4.6	3.2	3.65	3.35	4.62	5.6
21	5.6	3.3	7.05	8.6	4.79	5.6	4.2	3.6	3.62	3.32	4.6	5.82
22	5.45	3.3	7.15	8.45	4.87	5.0	4.25	3.5	3.6	3.55	4.55	5.7
23	5.9	3.3	7.1	8.1	4.67	6.1	3.28	3.38	3.5	4.2	4.45	5.6
24	5.6	3.3	7.3	8.15	4.6	6.25	4.28	3.35	3.25	4.25	4.45	5.45
25	5.15	3.1	9.55	7.85	4.54	5.55	3.95	3.3	3.85	4.28	4.4	6.15
26	5.3	2.8	9.85	7.8	4.46	6.65	3.72	3.28	3.75	4.3	4.32	6.1
27	5.7	3.25	10.9	7.6	4.22	6.55	3.52	−.21	3.6	4.35	4.7	5.95
28	5.75	3.2	11.05	7.6	3.68	6.4	3.45	3.22	3.45	4.38	4.72	5.85
29	3.15	.....	11.1	7.35	4.18	6.5	3.38	3.1	3.4	3.85	4.65	5.8
30	3.4	.....	11.0	7.5	3.95	6.4	3.45	3.4	3.28	4.4	4.62	5.6
31	3.4	.....	10.95	.....	3.88	.....	3.9	3.5	.....	4.32	.....	5.6

NOTE.—River frozen January 1 to March 19. No ice jams or anchor ice. During this period the above readings were to water surface in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 4	3.1	3.4	1.5
February 11	3.4	3.6	1.7
February 18	3.4	3.7	1.9
February 25	3.0	3.6	2.0
March 4	3.0	3.5	2.2
March 11	2.9	3.4	1.3
March 18	2.9	3.2	1.0

Station rating table for Oswego River at Battle Island, N. Y., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	1,050	1.80	2,470	3.60	4,820	6.80	10,950
0.10	1,110	1.90	2,580	3.70	4,980	7.00	11,390
0.20	1,175	2.00	2.690	3.80	5,130	7.20	11,820
0.30	1,245	2.10	2,800	3.90	5,300	7.40	12,260
0.40	1,310	2.20	2,910	4.00	5,470	7.60	12,700
0.50	1,380	2.30	3,020	4.20	5,820	7.80	13,130
0.60	1,450	2.40	3,140	4.40	6,170	8.00	13,580
0.70	1,520	2.50	3,270	4.60	6,540	8.50	14,700
0.80	1,590	2.60	3,400	4.80	6,910	9.00	15,830
0.90	1,660	2.70	3,530	5.00	7,300	9.50	16,990
1.00	1,750	2.80	3,660	5.20	7,690	10.00	18,190
1.10	1,830	2.90	3,790	5.40	8,090	10.50	19,360
1.20	1,910	3.00	3,930	5.60	8,490	11.00	20,540
1.30	2,000	3.10	4,070	5.80	8,890	11.50	21,760
1.40	2,090	3.20	4,220	6.00	9,300	12.00	22,970
1.50	2,180	3.30	4,360	6.20	9,710		
1.60	2,280	3.40	4.510	6.40	10,120		
1.70	2,380	3.50	4,660	6.60	10,540		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900–1904. It is fairly well defined above gage height 0.9 foot. Below this point estimates are only approximate.

Estimated monthly discharge of Oswego River at Battle Island, N. Y., for 1905.

[Drainage area, 4,990 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 20–31	20,780	10,120	16,220	3.25	1.4[illegible]
April	19,710	12,150	16,370	3.28	3.[illegible]
May	11,170	4,948	7,978	1.60	1.[illegible]
June	10,640	1,002	6,748	1.35	1.[illegible]
July	10,850	4,332	7,177	1.44	1.[illegible]
August	5,332	924	4,668	.935	1.0[illegible]
September	6,260	4,290	5,312	1.06	1.1[illegible]
October	6,170	900	4,731	.948	1.0[illegible]
November	7,790	5,560	6,730	1.35	1.51
December	9,610	6,508	8,387	1.68	1.[illegible]

SENECA RIVER AT BALDWINSVILLE, N. Y.

Seneca River receives the drainage from the central group of lakes lying south of Lake Ontario and unites with Oneida River at Three River Point to form the Oswego. The drainage basin is rolling, but the slopes are not precipitous except in the deep, narrow valleys in which the lakes are situated and in certain other valleys not at the present time occupied by lakes.

The gaging station was established November 12, 1898. It is located at the State dam in Baldwinsville, 12 miles along the river from the junction of Seneca and Oneida rivers.[a]

[a] The location of this station is shown on the Baldwinsville topographic atlas sheet of the United States Geological Survey.

The record at this station includes the discharge over the main dam, which is calculated by the formula for a broad, flat-crested weir when flashboards are removed; the discharge over the flashboards is calculated by the Francis formula. Gage readings in the river channel below the dam are utilized to determine the average working head on the turbines. The discharge through the three main canals is determined from records of the run of water wheels kept in each mill and from the recorded lockage and opening of paddles at the Oswego Canal lock at the foot of the canal.[a] Current-meter measurements, to determine the leakage of the several mills, have been made during 1905, as in previous years, and allowance for this leakage has been made. The record has also been checked by current-meter measurements made during 1901, 1903, 1904, and 1905 at Belgium.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 36, pp 183-184; 49, pp 222-223; 65, pp 128-129; 82, p 69; 97, p 394; 129, p 96.
Discharge: WS 47, p 39; 49, p 223; 65, p 129.
Discharge, daily: WS 36, p 184; 65, p 130; 82, p 69; 97, p 394; 129, p 97.
Discharge, monthly: WS 35, p 24; 65, p 131; 82, p 70; 97, p 395; 129, p 98.
Hydrograph: Ann 21, iv, p. 180.

Daily discharge, in second-feet, of Seneca River at Baldwinsville, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,367	3,375	2,171	9,416	5,001	2,642	5,566	2,696	2,134	1,413	2,982	3,138
2	4,108	3,224	2,212	8,664	4,769	2,715	4,801	2,651	2,081	2,056	3,100	2,979
3	4,276	2,855	2,304	8,912	4,579	2,550	5,658	2,566	1,470	2,106	3,015	2,579
4	3,972	3,069	2,368	8,690	4,394	1,726	5,488	2,491	2,073	2,109	3,025	3,610
5	3,712	2,463	1,890	8,593	4,451	2,552	5,306	2,116	2,080	2,106	2,469	3,708
6	3,671	3,158	2,355	8,540	4,289	2,555	5,065	1,563	2,099	2,116	3,239	3,818
7	3,271	3,002	2,148	8,240	3,714	2,604	4,769	2,176	2,125	2,071	3,021	3,798
8	2,692	3,136	2,194	7,910	4,446	2,772	4,781	2,174	2,095	1,449	3,137	3,848
9	3,470	3,097	2,237	7,154	4,363	2,928	3,811	2,170	2,065	2,090	3,232	3,913
10	3,521	3,175	2,186	7,473	4,231	2,953	4,510	2,161	1,324	2,109	3,247	3,036
11	3,622	4,965	2,051	7,421	4,122	1,316	4,312	2,132	2,112	2,119	3,138	3,877
12	3,762	2,323	1,773	7,351	4,056	2,424	3,980	2,113	2,094	2,106	2,819	3,829
13	3,952	3,049	2,301	6,979	3,937	3,803	3,968	1,251	2,127	2,232	3,219	3,739
14	3,811	2,553	2,195	6,839	3,044	2,452	4,285	2,032	2,121	2,291	3,097	3,889
15	3,217	2,687	2,154	6,642	3,879	2,847	4,171	2,039	2,161	2,769	3,097	3,895
16	3,752	2,754	2,354	5,692	3,836	2,925	3,241	2,176	2,104	3,114	3,137	3,225
17	3,701	2,720	2,370	6,303	3,796	2,911	3,983	2,426	1,441	3,022	3,177	2,246
18	3,628	2,566	2,442	6,099	3,747	2,516	3,898	2,449	2,065	2,942	3,003	2,988
19	3,708	1,943	2,483	6,015	3,756	4,205	3,748	2,407	2,054	2,936	2,769	3,049
20	3,608	2,527	4,380	5,767	3,771	4,822	3,608	1,857	1,996	3,052	2,976	3,006
21	3,571	2,495	4,702	5,637	2,883	5,167	3,288	2,339	1,996	3,021	2,789	3,166
22	3,027	2,491	4,865	5,735	3,532	5,471	3,243	2,271	1,974	2,919	2,780	3,646
23	3,569	2,400	5,297	4,947	3,495	5,659	2,241	2,271	1,963	3,109	2,674	4,011
24	3,387	2,507	6,195	5,493	3,376	5,784	3,053	2,018	1,369	3,055	2,582	3,782
25	3,309	2,445	7,318	5,510	3,344	5,126	2,951	1,964	2,134	3,055	2,665	4,043
26	3,015	1,983	7,282	5,450	3,184	6,006	2,914	2,056	2,146	3,055	2,554	4,433
27	3,015	2,643	9,186	5,330	3,231	6,050	2,686	1,215	1,989	3,017	2,770	4,191
28	2,967	2,610	9,392	5,245	2,596	5,856	2,713	2,073	1,976	2,750	2,560	4,086
29	2,577	.....	9,354	5,105	2,982	5,861	2,701	2,101	2,081	2,724	2,567	4,246
30	3,079	.....	9,514	4,437	2,568	5,669	1,981	2,092	1,964	2,810	3,065	4,328
31	3,135	.....	9,434	.....	2,843	.....	2,556	1,899	.....	2,868	.....	3,992

NOTE.—Crest of dam slightly obstructed by ice January 1 to March 19.

[a] See Rept. State Engineer and Surveyor of New York, Supplement, 1902, pp. 77-81; idem, 1903, pp. 39-40.

Estimated monthly discharge of Seneca River at Baldwinsville, N. Y., for 1905.

[Drainage area, 3,103 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,276	2,577	3,467	1.12	1.29
February	4,965	1,943	2,793	.899	[illegible]
March	9,514	1,773	4,165	1.34	1.54
April	9,416	4,437	6,720	2.16	2.41
May	5,001	2,568	3,749	1.21	1.[illegible]
June	6,050	1,316	3,762	1.21	1.[illegible]
July	5,658	1,981	3,848	1.24	1.[illegible]
August	2,696	1,215	2,127	.685	.7[illegible]
September	2,161	1,324	1,980	.638	.71[illegible]
October	3,114	1,413	2,535	.816	.94[illegible]
November	3,247	2,469	2,930	.943	1.05
December	4,433	2,246	3,616	1.16	1.34
The year	9,514	1,215	3,474	1.12	15.[illegible]9

Discharge measurements of Seneca River at Belgium, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
September 14	C. A. Poole	283	2,588	0.90	4.70	2.[illegible]
October 6	do	282	2,419	.96	4.10	2.[illegible]
October 27	do	283	2,588	1.14	4.70	2.944
November 24	do	282	2,503	1.14	4.40	2.[illegible]

CAYUGA LAKE AT ITHACA, N. Y.

A gaging station was established by E. C. Murphy at the head of Cayuga Lake August 6, 1905. A staff gage is used, attached to the wall of the breakwater about 150 feet from the light-house. Gage readings are taken once each day during the open season, and once a week during the winter by Fred Thomas.

Daily gage height, in feet, of Cayuga Lake at Ithaca, N. Y., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.3	2.1	1.6	0.9	17	2.4	2.25	2.0	1.05	.....
2	.....	2.3	2.05	1.55	.8	18	2.35	2.3	1.85	1.1	.....
3	.....	2.35	2.1	1.35	.95	19	2.2	2.35	2.05	1.15	.....
4	.....	2.45	2.1	1.4	.9	20	2.2	2.35	1.95	1.1	.....
5	.....	2.35	2.15	1.35	1.05	21	2.25	2.4	2.1	1.0	.....
6	2.2	2.45	2.15	1.4	1.0	22	2.28	2.25	1.95	.9	.....
7	2.3	2.4	2.0	1.35	.95	23	2.3	2.35	1.9	.9	1.[illegible]
8	2.2	2.45	2.0	1.4	1.05	24	2.32	2.3	1.85	.75	.....
9	2.2	2.35	1.95	1.35	.95	25	2.35	2.3	1.85	.75	.....
10	2.15	2.3	1.85	1.3	1.1	26	2.38	2.25	1.75	.8	.....
11	2.27	2.25	2.0	1.25	1.0	27	2.35	2.1	1.6	.85	.....
12	2.3	2.5	2.1	1.25	.95	28	2.2	2.15	1.7	.65	.....
13	2.32	2.5	2.15	1.3	1.05	29	2.3	2.1	1.65	.8	.....
14	2.25	2.4	2.15	1.25	1.1	30	2.35	2.1	1.55	.95	1.55
15	2.35	2.3	2.05	1.1	1.05	31	2.4	.....	1.6	.....	.....
16	2.45	2.3	2.05	1.1	.95						

SKANEATELES LAKE OUTLET AT WILLOW GLEN, N. Y.

Skaneateles Lake outlet enters Seneca River above Cross Lake, crossing the Erie Canal at Jordan. The fall from the foot of the lake to this point is 465 feet.

The surface of the lake has an elevation of 865 feet above tide. The valley on each side of the lake has an average width of 2.5 miles, and in this distance there is a rise of 400 to 800 feet, the greater part of it being within a mile of the lake. The inflow to the lake is through numerous short lateral feeders flowing down these slopes. The drainage areas of the lake are shown below:

Drainage areas of Skaneateles Lake. [a]

	Square miles.
Land surface above State dam at Skaneateles	60.25
Water surface of lake at Skaneateles	12.75
Total drainage area above foot of lake (water surface=17.46 per cent)	73.00
Total area above Willow Glen weir	74.25
Area above Erie Canal at Jordan	93.00

The station was established March 10, 1895. It is located in the village of Willow Glen, 1.5 miles below the foot of Shaneateles Lake.

Observation is made of the daily discharge over a thin-edged weir, having a crest length of 27 feet, with two end contractions. The discharge is calculated from the observed depth on a stake set with its top at crest level, 5.2 feet upstream from the weir, by means of the Francis formula, including corrections for end contractions and velocity of approach.

Since July 1, 1894, the water supply of the city of Syracuse has been drawn from Skaneateles Lake, and the amount of this diversion should be added to the discharge over Willow Glen weir to obtain the total run-off of the drainage basin. The calculated diversion, as determined from the record of gate openings and head at the inlet gates, using the formula for orifices with a constant coefficient stated as 0.62, has been furnished by the city of Syracuse. The observations at the weir and gates were taken by Edward Conron.

A complete description of the gagings which have been made on this stream is contained in the report on stream gagings in Supplement to Report of State Engineer and Surveyor of New York for 1902, pages 61–76. Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 67; 97, pp 395–396; 129, p 91.
Discharge: 65, p 121.
Discharge, daily: 65, pp 118–119, 123–126; 82, p 67; 97, p 396; 129, p 92.
Discharge, monthly: 65, p 122, 128; 82, p 68; 97, p 397; 129, pp 92–93.

Daily discharge, in second-feet, of Skaneateles Lake outlet at Willow Glen, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	82.8	80.0	69.6	36.1	32.0	59.7	64.6	59.7	69.6	91.2	91.2	85.5
2	82.8	80.0	69.6	36.1	32.0	59.7	64.6	59.7	69.6	91.2	91.2	85.5
3	80.0	74.7	69.6	36.1	32.0	59.7	64.6	59.7	69.6	91.2	91.2	91.2
4	80.0	69.6	69.6	38.3	59.7	59.7	62.1	59.7	69.6	91.2	91.2	91.2
5	80.0	69.6	69.6	38.3	59.7	59.7	62.1	59.7	69.6	91.2	91.2	91.2
6	80.0	69.6	69.6	38.3	59.7	59.7	62.1	59.7	69.6	91.2	91.2	91.2
7	85.5	69.6	69.6	36.1	54.8	69.6	59.7	57.2	69.6	91.2	91.2	40.5
8	82.8	69.6	69.6	36.1	49.9	64.6	59.7	54.8	69.6	91.2	91.2	40.5
9	80.0	72.2	69.6	36.1	47.5	59.7	59.7	54.8	64.6	91.2	91.2	40.5
10	80.0	72.2	69.6	36.1	59.7	59.7	59.7	54.8	64.6	97.2	91.2	40.5
11	80.0	72.2	69.6	38.3	59.7	62.1	59.7	57.2	67.1	100.0	91.2	40.5
12	82.8	74.7	69.6	36.1	59.7	59.7	62.1	59.7	67.1	97.2	91.2	40.5
13	80.0	72.2	69.6	36.1	59.7	59.7	64.6	64.6	64.6	91.2	91.2	40.5
14	80.0	69.6	38.3	36.1	62.1	59.7	64.6	69.6	64.6	91.2	91.2	40.5

[a] Areas here given have been taken from proceedings in condemnation of water powers on Skaneateles outlet. The lake and its tributary area are shown on the Skaneateles, Tully, Cortland, and Moravia topographic atlas sheets of the United States Geological Survey.

Daily discharge, in second-feet, of Skaneateles Lake outlet at Willow Glen, N. Y., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	80.0	69.6	45.1	36.1	59.7	59.7	64.6	69.6	64.6	91.2	91.2	40.5
16	80.0	69.6	49.9	36.1	59.7	64.6	64.6	64.6	64.6	91.2	91.2	40.5
17	80.0	69.6	52.3	36.1	59.7	85.5	62.1	64.6	64.6	91.2	91.2	.....
18	80.0	69.6	54.8	36.1	59.7	164.0	62.1	62.1	64.6	91.2	91.2	.....
19	80.0	69.6	54.8	36.1	59.7	91.2	62.1	59.7	91.2	94.2	91.2	.....
20	80.0	69.6	54.8	36.1	59.7	74.7	62.1	59.7	91.2	97.2	91.2	.....
21	80.0	69.6	67.1	36.1	59.7	80.0	62.1	59.7	91.2	91.2	88.3	.....
22	80.0	69.6	69.6	36.1	59.7	74.7	62.1	59.7	91.2	91.2	88.3	.....
23	80.0	69.6	74.7	36.1	59.7	69.6	62.1	59.7	91.2	91.2	85.5	.....
24	80.0	69.6	64.6	36.1	59.7	64.6	62.1	67.1	91.2	91.2	85.5	.....
25	80.0	69.6	64.6	34.0	59.7	64.6	59.7	67.1	91.2	91.2	85.5	.....
26	80.0	69.6	62.1	32.0	59.7	67.1	59.7	67.1	91.2	91.2	85.5	.....
27	80.0	69.6	59.7	32.0	59.7	64.6	57.2	69.6	91.2	91.2	85.5	.....
28	80.0	69.6	54.8	32.0	59.7	64.6	54.8	69.6	91.2	91.2	85.5	.....
29	80.0	.....	40.5	36.1	59.7	64.6	59.7	69.6	91.2	91.2	85.5	.....
30	80.0	.....	36.1	34.0	59.7	64.6	59.7	74.7	91.2	91.2	85.5	.....
31	80.0	.....	36.1	.....	59.7	.....	59.7	72.2	.....	91.2	.....	.....

Estimated monthly discharge of Skaneateles Lake outlet at Willow Glen, N. Y., for 1905.

[Drainage area, 74.2 square miles.]

Month.	Discharge in second-feet.			Run-off.[a]	
	In outlet.	Through conduit.	Total.	Second-feet per square mile.	Depth in inches.
January	80.5	18.9	99.4	1.34	1.54
February	71.1	19.2	90.3	1.22	1.27
March	60.8	[b] 19.4	80.2	1.08	1.24
April	35.8	19.6	55.4	.747	.833
May	56.2	19.1	75.3	1.01	1.16
June	69.1	18.2	87.3	1.18	1.31
July	61.5	19.1	80.6	1.09	1.26
August	62.8	.....	.....	.....	.....
September	76.7	.....	.....	.....	.....
October	92.2	.....	.....	.....	.....
November	89.5	.....	.....	.....	.....
December 1-16	58.8	.....	.....	.....	.....

[a] Including diversion for water supply of Syracuse. [b] Interpolated.

ONEIDA RIVER NEAR EUCLID, N. Y.

Oneida Lake has a water-surface area of 80 square miles and lies at an elevation of 370 feet above tide. The drainage basin within a radius of 10 miles to the south and west is relatively flat, with numerous marshy tracts. The lake receives, through Chittenango and Oneida creeks, drainage from an extensive area of the central New York plateau and, through Wood and Fish creeks on the east, drainage from a portion of the west slope of the plateau bordering the Adirondack Mountains. On the north the drainage area is less extensive and the inflowing streams are small.[a]

[a] A portion of the drainage area is shown on the Syracuse, Chittenango, Oneida, Oriskany, Morrisville, Cazenovia, and Tully topographic atlas sheets of the United States Geological Survey.

The outflow from the lake through Oneida River joins Seneca River at Three River Point, forming Oswego River. From Brewerton to Three River Point the distance in a straight line is but 8 miles; following the windings of the stream it is 16 miles.

The gaging station was established August 30, 1902. It is located 7 miles upstream from Three River Point.

Observations of stream stage, which are taken each morning and evening by Arthur McArthur, are made by measuring down to the water surface from a reference point on the bulkhead coping of the lock at Oak Orchard State dam, 0.4 mile above Schroeppel's bridge. The gage readings have been taken above the dam to avoid backwater from ice or other causes as far as possible. A calibration curve for the cross section of the stream at Schroeppel's bridge has been obtained by current-meter measurements.

Above a certain stage the dam becomes submerged and the discharge is modified. A special rating table deduced from measurements made during the period of submergence was used to calculate the discharge during the high-water period of 1904. Allowance is made for the opening of lock paddles in winter.

Information in regard to Oneida River is contained in the report on stream gagings in Supplement to Report of State Engineer and Surveyor of New York, 1902, pages 82-84. Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 381-382; 129, p 102.
Discharge: 97, p 382; 129, p 103.
Discharge, daily: 97, pp 384-385; 129, p 103.
Discharge, monthly: 97, p 386; 129, p 104.
Rating table: 97, p 383.

Discharge measurements of Oneida River near Euclid, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 3	C. C. Covert	265	933	2.33	4.10	2,175
August 29	do	270	995	1.46	4.64	1,457

Daily discharge, in second-feet, of Oneida River near Euclid, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,040	2,450	1,250	12,010	5,560	2,210	3,260	2,070	1,780	1,780	2,630	2,500
2	2,160	2,300	1,250	12,240	5,930	2,070	3,060	1,920	1,950	1,640	2,850	2,880
3	2,190	2,010	1,250	12,320	5,680	2,000	3,160	1,920	2,210	1,500	2,980	3,420
4	2,450	1,800	1,250	12,880	5,440	2,070	3,060	1,920	2,250	1,640	2,550	3,620
5	2,370	1,660	1,200	12,960	5,560	2,070	3,020	1,920	2,340	1,640	2,550	3,880
6	2,300	1,560	1,250	13,120	5,190	1,950	3,060	1,780	2,470	1,500	2,550	4,030
7	2,230	1,560	1,150	13,120	5,080	2,340	3,060	1,780	2,550	1,540	2,630	4,130
8	2,230	1,610	1,200	13,200	4,970	2,000	2,940	1,780	2,510	1,570	3,060	4,130
9	2,300	1,660	1,250	12,960	4,520	2,040	2,850	2,000	2,550	1,640	2,980	4,130
10	2,370	1,660	1,200	12,560	4,740	2,070	2,630	1,920	2,720	1,640	3,160	4,030
11	2,450	1,660	1,150	12,160	4,520	2,040	2,590	1,880	2,470	1,780	3,160	5,070
12	2,540	1,660	1,200	12,010	4,410	2,070	2,420	1,740	2,470	1,880	3,110	4,030
13	2,540	1,560	1,200	11,710	4,290	2,040	2,420	1,780	2,380	2,000	2,940	5,180
14	2,710	1,610	1,200	11,260	4,180	2,070	2,340	1,780	2,380	2,070	3,060	4,790
15	2,630	1,610	1,150	10,900	4,070	2,040	2,340	1,920	2,550	2,070	2,980	4,340
16	2,630	1,560	1,150	10,230	3,870	2,040	2,380	2,000	2,380	2,000	2,890	3,620
17	2,450	1,460	1,150	9,520	3,670	2,550	2,340	2,040	2,380	2,000	2,800	3,570
18	2,370	1,510	1,150	9,100	3,560	2,070	2,250	1,880	2,380	2,070	2,980	3,420
19	2,370	1,460	1,150	9,100	2,980	2,000	2,070	1,880	2,210	2,180	2,980	3,220
20	2,300	1,460	1,410	8,700	3,160	2,070	1,920	1,820	2,210	2,070	2,890	3,270

Daily discharge, in second feet, of Oneida River near Euclid, N. Y., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2,230	1,460	1,610	8,420	3,060	2,000	1,920	1,740	2,210	2,000	2,800	3,420
22	2,300	1,410	1,800	8,150	2,890	2,070	1,950	1,570	2,340	2,210	2,800	3,620
23	2,450	1,350	2,010	8,150	2,720	2,070	1,850	1,400	2,210	2,420	2,720	3,720
24	2,540	1,350	2,370	8,020	2,890	3,160	1,780	1,300	2,070	2,590	2,720	3,620
25	2,790	1,350	3,930	7,490	2,800	2,800	1,600	1,090	2,000	2,760	2,680	3,720
26	3,520	1,300	5,840	7,360	2,720	2,720	1,570	990	2,000	2,980	2,630	3,830
27	3,[illegible]20	1,250	8,150	6,970	2,720	2,980	1,640	1,240	1,920	2,980	2,470	3,530
28	2,630	1,300	9,520	6,840	2,550	3,060	1,640	1,400	1,920	2,630	2,420	4,080
29	2,230	.....	10,380	6,580	2,550	2,890	2,040	1,500	1,780	2,550	2,680	4,130
30	2,230	.....	11,110	6,250	2,380	2,800	2,070	1,500	1,920	2,550	2,510	3,670
31	2,370	.....	11,410	.....	2,380	.....	2,000	1,680	2,070	2,550	.....	3,930

Estimated monthly discharge of Oneida River near Euclid, N. Y., for 1905.

[Drainage area, 1,313 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	3,520	2,040	2,459	1.87	2.16
February	2,450	1,250	1,592	1.21	1.26
March	11,410	1,150	2,977	2.27	2.62
April	13,200	6,250	10,210	7.78	8.68
May	5,930	2,380	3,905	2.97	3.42
June	3,160	1,950	2,279	1.74	1.94
July	3,260	1,570	2,362	1.80	2.08
August	2,070	990	1,714	1.31	1.51
September	2,720	1,780	2,240	1.71	1.91
October	2,980	1,500	2,078	1.58	1.82
November	3,160	2,420	2,805	2.14	2.39
December	5,180	2,500	3,833	2.92	3.37
The year	13,200	990	3,204	2.44	33.16

CHITTENANGO CREEK AT CHITTENANGO, N. Y.

This station was established May 22, 1901. It is located at the Main Street Bridge in the village of Chittenango and is one-half mile above the State dam diverting water for the supply of the summit level of Erie Canal.

The stream at this point is confined between parallel walls, affording a channel 50 feet wide, over which the bridge passes in a single span, having a length of 57 feet between abutments. The bridge is built at an angle with the normal to the stream.

Discharge measurements are made from the upstream side of the Main Street Bridge. The initial point for soundings is the face of the right abutment, upstream side.

The gage board, which is observed twice daily by Miss Bessie M. Kellogg, is secured in a vertical position to the right abutment on the upstream side, and reads decimally from zero to 8 feet. The bench mark is on the upstream corner of the coping of the right abutment; its elevation is 8.23 feet above gage datum.

The flow of Chittenango Creek above Chittenango is regulated by storage in Cazenovia Lake and Erieville reservoir.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 114-115; 82, pp 65-66; 97, pp 386-387; 129, pp 104-105, 107.
Discharge: 65, p 115; 82, p 66; 97, p 387; 129, p 105.
Discharge, daily: 97, pp 390-392.
Discharge, monthly: 97, p 393; 129, p 106.
Gage heights: 65, p 116; 82, p 66; 97, p 388; 129, p 105.
Rainfall data: 97, p 393.
Rating table: 97, pp 388-389; 129, p 106.
Water powers: 65, p 116.

Discharge measurements of Chittenango Creek at Chittenango, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 30	C. J. Wood	53	183	1.87	2.55	342
August 31	do	53	183	1.77	2.50	324

Daily gage height, in feet, of Chittenango Creek at Chittenango, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.75	1.65	1.35	2.7	1.65	1.45	1.85	1.85	1.95	1.35	1.8	1.75
2	1.9	1.75	1.4	2.35	1.7	1.4	2.35	1.55	1.65	1.5	1.85	1.55
3	1.85	1.7	1.3	2.2	1.75	1.45	2.25	1.45	2.0	2.3	1.7	1.95
4	1.9	1.5	1.3	2.75	1.7	1.4	1.85	1.45	2.1	2.35	1.65	1.75
5	1.85	1.7	1.35	3.3	1.65	1.5	1.75	1.45	1.95	2.45	1.7	1.95
6	1.85	1.85	1.3	2.7	1.7	1.75	1.7	1.45	1.9	2.5	1.65	1.85
7	3.7	1.4	1.3	2.85	1.65	1.55	1.65	1.5	1.95	2.55	1.85	1.9
8	2.6	1.45	1.35	2.45	1.6	1.65	1.6	1.45	1.8	2.45	1.85	2.05
9	2.25	1.4	1.35	2.4	1.65	1.85	1.45	1.45	1.8	2.45	1.8	1.95
10	1.95	1.5	1.25	2.5	1.6	1.65	1.35	1.4	1.7	2.5	1.85	1.95
11	1.85	1.5	1.3	2.85	1.65	1.45	1.35	1.4	1.6	2.8	1.8	2.05
12	1.95	1.5	1.25	2.65	1.6	1.45	1.45	1.55	2.45	2.7	1.65	1.85
13	1.8	1.45	1.35	2.25	1.65	1.35	1.55	1.5	2.05	1.9	1.7	1.95
14	1.95	1.45	1.35	2.15	1.75	1.3	1.5	1.5	1.85	1.85	1.6	2.05
15	2.0	1.35	1.25	2.05	1.95	1.35	2.75	1.45	1.7	1.65	1.7	1.95
16	2.0	1.35	1.3	2.2	1.85	1.55	2.3	2.9	1.6	1.45	1.8	2.05
17	1.9	1.45	1.35	2.05	1.9	1.75	2.0	2.0	1.6	1.5	1.85	2.1
18	2.0	1.4	1.4	2.15	1.95	1.85	1.9	1.5	1.5	1.6	1.75	2.05
19	1.85	1.4	3.5	2.4	1.85	1.95	1.75	1.55	1.5	1.7	1.7	1.85
20	1.9	1.45	2.85	2.25	1.8	2.15	1.55	1.45	1.6	1.8	1.7	1.95
21	1.75	1.4	2.55	2.15	1.7	3.2	1.45	1.45	1.6	1.95	1.68	2.5
22	1.65	1.35	2.3	2.25	1.55	3.45	1.4	1.45	1.5	1.85	1.6	2.35
23	1.6	1.45	2.65	1.95	1.35	2.9	1.25	1.45	1.5	1.75	1.65	1.95
24	1.55	1.4	3.35	1.75	1.25	2.5	1.25	1.4	1.5	1.6	1.8	1.85
25	1.45	1.3	4.15	1.8	1.25	2.05	1.3	1.3	1.4	1.5	1.8	1.95
26	1.6	1.35	3.6	1.65	1.4	2.2	1.35	1.35	1.4	1.5	1.7	2.05
27	1.45	1.4	3.85	1.7	1.35	2.3	1.25	1.3	1.4	1.6	1.75	1.95
28	1.5	1.35	3.65	1.75	1.4	2.15	1.35	1.3	1.35	1.5	1.65	2.0
29	1.55	.....	3.4	1.65	1.45	1.95	1.45	1.3	1.35	1.55	1.85	1.95
30	1.6	.....	3.35	1.7	1.4	1.85	1.3	3.15	1.3	1.55	1.95	2.15
31	1.65	.....	3.35	.....	1.45	.....	1.65	2.75	.....	1.75	.....	2.05

NOTE.—River frozen January 1 to March 18; two-thirds across to the end of January and entirely across February 1 to March 18. No anchor ice. Ice broke up along the edges during the early part of March. Ice 0.1 to 0.8 foot thick. Readings are to water surface.

Station rating table for Chittenango Creek at Chittenango, N. Y., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	30	1.90	135	2.80	440	3.70	910
1.10	35	2.00	155	2.90	485	3.80	970
1.20	40	2.10	180	3.00	530	3.90	1,035
1.30	50	2.20	210	3.10	580	4.00	1,100
1.40	60	2.30	240	3.20	630	4.10	1,170
1.50	70	2.40	275	3.30	680	4.20	1,240
1.60	85	2.50	315	3.40	735		
1.70	100	2.60	355	3.50	790		
1.80	115	2.70	395	3.60	850		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5, and is well defined.

Estimated monthly discharge of Chittenango Creek at Chittenango, N. Y., for 1905.

[Drainage area, 79 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 19-31	1,205	240	692	8.76	4.24
April	680	92	249	3.15	3.51
May	145	45	90.4	1.14	1.31
June	762	50	168	2.13	2.38
July	418	45	105	1.33	1.53
August	605	50	111	1.41	1.63
September	295	50	104	1.32	1.47
October	440	55	165	2.09	2.41
November	145	85	108	1.37	1.53
December	315	78	155	1.96	2.26

SALMON RIVER BASIN.

SALMON RIVER NEAR PULASKI, N. Y.

Salmon River rises in the southwestern part of Lewis County, N. Y., flows first southward then northwestward, and enters Lake Ontario near Port Ontario. The basin above the gaging station is rolling and very sandy, rock lying near the surface in the upper part of the watershed, where there are also extensive tracts of original forest. The region is subject to heavy falls of snow, which sometimes accumulates in the forest areas to a depth of several feet and the gradual melting of which during March and April feeds the stream.

The gaging station was established September 5, 1900. It is located at Fox Bridge, near Pulaski, N. Y. [a]

The stream bed is of gravel and cobble, relatively flat and shallow. The bridge consists of two spans, 183.5 feet between abutments. There are two small overflow channels and a flood plain.

Current-meter measurements are made at 5-foot intervals across the stream from the downstream side of the bridge. The initial point for soundings is the face of the abutment at the right end of the bridge on the downstream side.

[a] The location of the gaging station is shown on the Pulaski topographic atlas sheet of the United States Geological Survey.

The original gage was a vertical board scale attached to the upstream end of the center pier, having its zero mark 11.59 feet below the bench mark, which was the top of the capstone of the central pier, upstream end. This gage was carried away by ice in the winter of 1901-2, and was replaced July 23, 1902, by a standard weight-and-chain gage, having its datum at elevation 12.79 feet below the bench mark. The gage readings are taken twice each day by S. J. Fox, and have been continued throughout summer and winter, the winter readings being obtained by observing the height to which the water rises in a hole in the ice. Owing to the obstruction of the river channel by ice, the discharge for the winter period has not been deduced.

A measurement made June 2, 1905, by C. C. Covert showed a discharge of 404 second-feet at gage height 3.03 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 49, p 234; 65, p 105; 82, pp 64, 65; 97, p 373; 129, pp 107-108.
Discharge: 47, p 39; 49, p 234; 65, p 106; 82, p 64; 97, p 374; 129, p 108.
Discharge, daily: 65, pp 106-107; 82, p 65; 97, p 377.
Discharge, monthly: 65, p 107; 82, p 65; 97, p 377; 129, p 109.
Gage heights: 49, p 234; 97, p 375; 129, p 108.
Rating table: 97, p 376; 129, p 109.
Water powers: 65, p 106.

Daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.94	.....	.....	6.39	4.62	3.16	3.18	3.7	2.9	2.55	3.6	3.95
2	3.86	.....	.....	5.54	4.22	3.04	3.35	3.4	2.72	2.55	3.7	3.9
3	3.64	.....	.....	5.19	4.04	3.1	3.65	3.15	4.0	3.15	3.45	5.48
4	.....	.....	.....	5.19	4.26	3.02	3.3	2.95	4.32	3.15	3.4	5.1
5	.....	.....	.....	7.14	4.39	3.02	3.15	2.8	3.7	3.0	3.38	4.28
6	.....	.....	.....	6.54	4.12	3.32	3.02	2.88	3.5	2.9	3.68	4.0
7	.....	.....	.....	5.44	4.49	3.38	2.98	3.75	3.22	2.75	5.05	3.9
8	.....	.....	.....	4.74	4.39	3.5	2.95	3.38	3.05	2.7	4.55	3.72
9	.....	.....	.....	4.34	4.04	3.38	2.92	3.1	2.9	2.7	4.35	3.55
10	.....	.....	.....	4.54	3.92	3.1	2.88	2.9	2.88	2.65	4.05	3.5
11	.....	.....	.....	4.99	3.69	3.3	2.8	2.9	2.8	2.65	3.85	3.12
12	.....	.....	.....	5.29	3.52	4.12	2.98	3.22	2.92	4.55	3.72	3.32
13	.....	.....	.....	5.29	3.46	3.75	3.0	3.6	2.98	5.62	4.02	3.32
14	.....	.....	.....	5.36	3.34	3.42	3.68	3.15	2.92	5.1	4.25	3.25
15	.....	.....	.....	4.79	3.54	3.18	3.35	3.08	2.82	4.2	3.82	2.98
16	.....	.....	.....	4.49	3.56	3.08	3.05	3.8	2.75	3.82	3.7	3.0
17	.....	.....	.....	4.16	3.52	4.55	2.92	3.5	2.75	3.48	3.55	3.1
18	.....	.....	.....	3.92	3.59	6.05	2.88	3.2	2.72	3.32	3.48	3.15
19	.....	.....	.....	3.74	3.99	4.58	2.8	3.02	2.85	4.45	3.45	3.25
20	.....	.....	.....	3.74	3.94	4.6	2.98	2.82	2.88	4.5	3.25	3.28
21	.....	.....	.....	4.94	3.54	4.25	2.9	2.78	2.9	4.5	3.15	3.5
22	.....	.....	.....	5.64	3.42	3.85	2.75	2.75	2.82	4.1	3.15	4.78
23	.....	.....	.....	4.96	3.29	3.62	2.7	2.62	2.72	4.15	3.2	4.8
24	.....	.....	.....	4.69	3.16	3.3	2.7	2.65	2.7	4.2	3.22	4.2
25	.....	.....	.....	4.62	3.06	3.18	2.72	2.6	2.65	4.08	3.5	3.9
26	.....	.....	.....	4.62	3.12	4.3	2.7	2.6	2.62	3.8	3.72	3.75
27	.....	.....	.....	4.64	3.86	5.02	2.62	2.55	2.6	3.55	3.8	3.55
28	.....	.....	.....	4.74	3.56	4.02	2.6	2.6	2.6	3.48	3.5	3.9
29	.....	.....	.....	4.79	3.32	3.58	2.7	2.62	2.62	3.35	4.42	4.25
30	.....	.....	6.49	5.14	3.39	3.35	5.02	2.78	2.58	3.28	5.55	4.75
31	.....	.....	6.59	.....	3.32	.....	4.55	3.02	.....	3.22	.....	4.3

NOTE.—River frozen solid to bottom January 1 to night of March 29. Flow sometimes entirely out of channel on flats, at other times water flowed over ice.

Station rating table for Salmon River near Pulaski, N. Y., from January 1, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	110	3.60	781	4.70	2,140	5.80	4,490
2.50	144	3.70	865	4.80	2,300	5.90	4,780
2.60	181	3.80	965	4.90	2,470	6.00	5,100
2.70	218	3.90	1,060	5.00	2,640	6.20	5,770
2.80	265	4.00	1,170	5.10	2,840	6.40	6,530
2.90	312	4.10	1,300	5.20	3,020	6.60	7,340
3.00	364	4.20	1,420	5.30	3,240	6.80	8,190
3.10	422	4.30	1,450	5.40	3,460	7.00	9,070
3.20	480	4.40	1,680	5.50	3,700	7.20	10,000
3.30	550	4.50	1,830	5.60	3,950	7.40	11,000
3.40	620	4.60	1,980	5.70	4,200	7.60	12,060
3.50	697						

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902-1905. It is well defined between gage heights 2.45 feet and 3.25 feet. Above gage height 3.25 feet the curve is based on three measurements at 6.3 feet.

Estimated monthly discharge of Salmon River near Pulaski, N. Y., for 1905.

[Drainage area, 264 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	9,720	905	2,927	11.09	12.37
May	2,012	399	955	3.62	4.17
June	5,265	376	1,043	3.95	4.41
July	2,680	181	488	1.85	2.13
August	965	181	411	1.56	1.80
September	1,476	174	374	1.42	1.58
October	4,000	200	972	3.68	4.24
November	3,825	451	1,048	3.97	4.43
December	3,652	354	1,131	4.28	4.93

BLACK RIVER BASIN.

DESCRIPTION OF BASIN.

Black River rises in the western part of Hamilton County, N. Y., flows southwestward across Herkimer County into Oneida County, turns near Forestport and runs somewhat west of north through Lewis County to eastern Jefferson County, and then flows westward to Black River Bay, at the eastern extremity of Lake Ontario. The upper part of the basin is very rugged and mountainous and contains a large number of lakes.

The regimen of the river is controlled by storage on its upper tributaries, including Beaver River at Beaver, a series of reservoirs at the headwaters of Moose River, and additional reservoirs at Forestport and on the headwaters of the main river.

Water is diverted from Black River through Forestport feeder to supply the Black River Canal at Boonville. A portion of this diverted water flows northward from Boonville and enters Black River again at Lyons Falls; the remainder flows southward through the Black River Canal and enters the Erie Canal at Rome. The amount of this diversion, which takes place during the season of canal navigation, is not recorded.

Measurements made by the New York barge canal survey in 1900 and 1905, and by the United States Geological Survey in 1905 showed the following amounts of flow in the Black River Canal south of the Forestport feeder:

Discharge measurements of Black River Canal at the highway bridge below Lock No. 7 near Boonville, N. Y., in 1900 and 1905.

Date.	Elevation of water surface.	Discharge.
1900.	*Feet.*	*Sec.-ft.*
August 21	.....	197
September 24	.....	242
November 7	.....	254
December 1	.....	181
1905.		
August 17	488.22	136
August 18	488.32	117
September 7	488.40	158
September 22	488.29	143
November 8	488.30	131

BLACK RIVER NEAR FELTS MILLS, N. Y.

This station was established August 29, 1902. It is located at the dam of the Black River Traction Company, near the village of Felts Mills. The dam is 9 miles upstream from Watertown and 7 miles upstream from the old Huntingtonville gaging station on this stream. The drainage area is estimated at 1,851 square miles, or 37.5 square miles less than at Huntingtonville. The intervening area is mainly drained by two small streams, Townsend and Rutland Hollow creeks.

The dam is of squared timber, rests on limestone foundation, and is very nearly water-tight. It has a slope on the upstream face of 2.88 horizontal to 1 vertical. The crest is protected by boiler plate and the downstream face is vertical, giving a free overfall. The main crest is 380.6 feet long. There are two additional sections on the right-hand side, one 14.1 feet long and the other 17.9 feet. A similarly constructed dam, 117 feet long, at the left bank serves as an auxiliary spillway and as a headrace wall. The headrace is closed by a bulkhead, no water wheels having been installed.

The gage, which was read twice daily during 1905, at 7 a. m. and 6 p. m., by William Vineall, is attached vertically to a crib at the junction of the main and auxiliary spillways, 12 feet upstream from the crest, and correction is made to the gage readings for velocity of approach during high water. The discharge over the spillways has been calculated by means of the weir formula, using coefficients derived from experiments of the United States Geological Survey for a dam of similar cross section.

Owing to continuous discharge over the dam to a considerable depth during the years 1903 and 1904, it has not been possible to obtain a new profile of the crest. The discharge has been calculated from the known elevations of the ends of the crest, and the results given are subject to revision. Settlement of the crest, if any has taken place, would have the effect of making the discharge at a given gage height greater than that given in the accompanying tables.

During 1905 a wood-pulp mill was erected at one end of this dam, but was not operated The record will be continued when the mill is in operation by including the recorded discharge through the turbines in the calculation of the flow.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, pp 62-63; 97, pp 363-364; 129, pp 110-111.
Discharge, daily. 82, p 63; 129, pp 111-112.
Discharge, monthly: 82, p 64; 129, p 113.

Daily discharge in second-feet of Black River near Felts Mills, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,690	2,080	1,520	17,900	6,890	3,130	7,600	3,970	1,470	1,320	1,750	4,3[illegible]
2	3,970	2,210	1,520	17,000	7,700	2,800	6,300	.....	1,220	1,520	1,580	4,7[illegible]
3	3,470	2,600	1,520	15,700	7,300	2,210	5,720	.....	1,220	1,420	1,860	3,8[illegible]
4	2,660	2,470	1,020	12,500	6,500	1,860	5,720	.....	4,200	1,970	1,860	3,2[illegible]
5	2,280	2,470	1,020	14,100	6,110	1,860	6,110	.....	4,350	1,860	.....	3,8[illegible]
6	2,210	2,730	1,420	16,100	5,920	2,730	5,560	.....	7,090	1,640	3,270	4,4[illegible]
7	2,210	2,150	1,320	18,200	5,920	3,340	4,430	3,760	9,750	1,520	5,070	4,5[illegible]
8	2,210	2,340	1,120	14,700	5,720	3,470	1,370	3,470	4,510	1,320	5,070	4,7[illegible]
9	2,210	2,470	1,120	12,500	5,640	3,830	3,130	3,070	3,900	1,520	5,070	4,[illegible]
10	2,210	2,210	932	10,700	5,560	3,830	2,730	2,540	3,470	1,320	4,910	4,4[illegible]
11	2,150	2,080	847	9,750	4,910	3,270	2,340	2,030	3,340	1,320	4,430	3,4[illegible]
12	1,970	1,920	804	10,400	4,590	3,270	2,030	2,030	2,540	1,320	3,620	3,4[illegible]
13	1,860	1,970	1,020	9,990	4,200	5,150	2,150	1,690	2,540	2,210	3,540	3,[illegible]
14	2,340	1,970	975	10,500	1,120	4,910	2,210	2,280	2,340	2,600	3,620	3,4[illegible]
15	2,470	2,340	1,020	9,990	890	4,120	2,600	2,930	1,640	3,130	3,540	3,2[illegible]
16	2,470	2,030	1,120	9,870	932	3,400	2,470	6,010	1,750	3,970	3,130	2,4[illegible]
17	2,600	1,920	975	8,810	1,020	6,300	2,730	5,320	1,370	3,270	3,000	2,5[illegible]
18	2,410	1,970	890	7,810	975	7,920	2,930	4,510	1,640	2,600	3,000	3,[illegible]
19	2,280	2,210	1,520	5,920	847	9,280	3,540	3,470	2,800	2,340	2,600	1,[illegible]
20	1,970	2,340	2,860	5,400	932	10,200	4,590	2,470	3,270	3,540	2,410	1,[illegible]
21	1,640	1,970	3,830	6,110	932	10,500	4,990	2,210	2,730	5,070	2,340	2,[illegible]
22	1,750	1,750	3,830	7,500	847	9,160	4,590	1,690	3,970	4,120	3,830	2,4[illegible]
23	1,800	1,520	4,270	8,590	761	7,920	3,130	1,690	3,690	3,830	3,690	3,2[illegible]
24	1,920	1,640	4,750	10,200	453	7,090	2,210	1,370	3,200	3,400	3,200	3,[illegible]
25	1,970	1,520	6,690	9,990	351	5,560	1,920	975	2,540	3,000	2,860	2,5[illegible]
26	1,750	1,370	8,250	9,280	316	6,690	1,800	633	2,080	1,750	2,660	4,9[illegible]
27	1,690	1,320	9,520	8,590	556	8,140	1,690	419	1,750	2,080	2,540	4,[illegible]
28	2,280	1,370	10,200	8,480	761	8,480	1,640	487	1,750	2,340	2,660	3,5[illegible]
29	1,860	.....	10,700	7,920	2,800	8,590	1,640	351	1,580	2,730	3,340	3,4[illegible]
30	(a)	.....	14,700	6,890	3,270	8,480	1,970	419	1,370	2,340	4,910	5,4[illegible]
31	2,080	.....	17,000	.....	3,270	.....	2,730	633	.....	1,860	.....	5,5[illegible]

a Record doubtful.

Estimated monthly discharge of Black River near Felts Mills, N. Y., for 1905.

[Drainage area, 1,851 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January (30 days)	3,970	1,640	2,279	1.23	1.42
February	2,730	1,320	2,034	1.09	1.14
March	17,000	804	3,816	2.06	2.38
April	18,200	5,400	10,710	5.79	6.4[illegible]
May	7,700	316	3,161	1.71	1.97
June	10,500	1,860	5,583	3.01	3.3[illegible]
July	7,600	1,640	3,373	1.82	2.10
August (26 days)	6,010	351	2,324	1.26	1.22
September	9,750	1,220	2,969	1.60	1.79
October	5,070	1,320	2,395	1.29	1.49
November (29 days)	5,070	1,580	3,288	1.78	1.92
December	5,560	1,860	3,607	1.95	2.25

MOOSE RIVER AT MOOSE RIVER, N. Y.

Moose River is tributary to Black River at Lyons Falls, N. Y. Its drainage basin lies chiefly in Herkimer and Hamilton counties and comprises a wild, rugged, and uninhabited region, largely forest-covered, but containing also extensive tracts of cut and burned-over lands. The flow of the stream is more or less regulated by lumbermen's dams, the storage of which is utilized for floating logs.

The gaging station was established June 5, 1900. It is located at Moose River village.

The stream is smooth above the gaging station to the foot of McKeever dam, 2 miles upstream, but a short distance above the gage it is divided by an island which creates an ice jam during freshets. A short distance below the station a fall occurs. The bed of the stream is of cobble with occasional bowlders, the current is smooth, and the depth is fairly uniform. The stream freezes over in winter, alternate layers of ice and snow or slush often forming in such a manner as to prevent discharge measurements being made.

A cableway, having a clear span of 269 feet, was erected in June, 1903, from which current-meter measurements have since been made. The initial point for soundings is the left support of the cable.

The gage, which is read twice daily by Chris Hannan, consists of a graduated board scale, attached to posts on the left bank of the stream, and comprises a high-water and a low-water section. During the ice season the gage is read once each week. The gage was carried out by an ice freshet in February, 1903, and was replaced at a slightly different elevation. The bench mark is on the top of a bowlder on the left bank, 300 feet upstream from the cableway. Its elevation above the gage zero prior to February 28, 1903, was 15.36 feet; after February 28, 1903, 15.53 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 49, pp 234-235; 82, p 60; 97, p 371; 129, p 114.
Discharge: 97, p 371; 129, p 115.
Gage heights: 49, p 235; 65, p 99; 82, p 61; 97, p 372; 129, p 115.

Daily gage height, in feet, of Moose River at Moose River, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.05	2.1	2.3	5.9	4.15	2.7	3.45	3.35	2.7	1.52	2.5	2.9
2	2.8	2.15	2.4	5.1	3.55	2.2	4.05	2.85	2.75	1.75	3.35	2.45
3	2.65	2.0	2.35	4.7	3.2	2.1	5.0	2.2	4.35	2.1	2.95	2.8
4	2.55	2.05	2.4	4.55	3.65	2.07	4.25	2.1	6.65	2.35	2.75	3.35
5	2.4	2.0	2.3	6.05	4.25	2.1	3.85	1.8	6.6	2.05	2.45	3.3
6	2.3	2.0	2.22	6.2	4.0	2.3	3.45	1.75	4.35	2.15	2.45	3.15
7	2.35	1.92	2.22	5.25	3.95	2.75	3.3	2.45	4.1	2.25	3.05	2.9
8	2.3	1.92	2.22	4.6	3.9	3.0	2.95	2.5	3.85	1.85	3.25	2.65
9	2.35	2.05	2.22	4.35	3.85	3.45	2.75	2.3	3.65	1.9	3.05	2.55
10	2.2	2.1	2.3	4.55	3.75	3.05	2.2	1.95	3.2	1.85	2.55	2.35
11	2.2	2.2	2.22	5.0	3.5	3.15	2.05	1.75	2.75	2.25	2.45	2.25
12	2.35	2.25	2.22	4.7	3.45	3.3	1.95	2.05	2.55	3.4	2.3	2.35
13	2.4	2.3	2.22	4.9	3.45	3.85	2.2	2.2	2.6	3.9	2.2	2.2
14	2.55	2.45	2.35	5.05	3.55	3.65	2.65	2.1	2.3	3.45	2.55	2.15
15	2.5	2.4	3.0	4.8	3.1	3.15	3.0	2.0	1.95	3.05	2.45	2.0
16	2.4	2.3	2.8	4.35	2.75	2.5	2.55	3.2	1.75	2.65	2.35	2.0
17	2.4	2.35	2.35	4.05	2.45	4.5	2.65	3.1	1.65	2.4	2.4	1.95
18	2.3	2.3	2.35	3.7	2.3	6.6	3.35	2.6	2.05	2.55	2.8	2.0
19	2.25	2.35	2.45	3.4	2.3	4.85	3.6	2.4	3.3	2.8	2.35	2.1
20	2.3	2.4	2.55	3.27	2.55	4.8	4.1	2.25	3.85	3.4	1.9	1.9
21	2.2	2.35	2.75	3.9	2.45	4.95	3.8	2.05	4.4	3.55	2.0	1.82
22	2.25	2.45	3.0	7.1	2.6	4.65	3.25	1.95	4.0	3.25	1.95	2.1
23	2.2	2.4	3.15	5.2	2.65	4.2	2.8	1.75	3.5	2.8	1.8	2.1

Daily gage height, in feet, of Moose River at Moose River, N. Y., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
24	2.35	2.35	3.0	4.4	2.35	3.8	2.35	1.5	3.05	2.65	1.72	2.45
25	2.3	2.3	3.15	4.25	1.8	3.35	2.0	1.25	2.5	2.65	1.75	2.5
26	2.2	2.3	3.25	4.4	1.67	4.9	2.05	1.17	2.25	2.45	1.85	2.1
27	2.35	2.35	3.45	4.2	2.5	5.85	1.95	1.25	2.1	2.05	1.95	2.0
28	2.2	2.3	3.6	4.3	2.7	4.95	1.9	1.5	1.9	2.0	1.95	1.9
29	2.12	.....	3.9	4.5	2.85	4.25	1.82	1.5	1.75	2.05	2.25	2.2
30	2.12	.....	4.5	5.3	2.95	3.9	2.25	1.6	1.62	1.9	3.05	2.3
31	2.12	.....	6.6	.....	3.3	.....	3.7	2.8	.....	1.75	.....	3.1

NOTE.—River frozen January 1 to March 31; readings are to the surface of the water in a hole cut in the ice. January 20–28, ice at gage 14 inches thick. January 31, 2 inches of water on ice, also deep snow; stream frozen over throughout; no anchor ice; ice at gage 14 inches thick. February 4, conditions as above, but ice thickness 19 inches at gage and elsewhere. February 11, same; stream not frozen at rapids under bridge. February 18, same as preceding; ice thickness 19 to 20 inches; 2 feet of snow on ice. February 25, same as preceding; ice thickness 16 inches. March 4 and 11, same as preceding. March 18, layer of snow and water on ice has frozen; total ice thickness 2 feet. March 30, river breaking up. No ice during December.

Station rating table for Moose River at Moose River, N. Y., from June 5, 1900, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	127	1.50	382	2.80	914	4.10	1,780
.30	140	1.60	412	2.90	968	4.20	1,870
.40	154	1.70	444	3.00	1,023	4.30	1,960
.50	170	1.80	477	3.10	1,080	4.40	2,060
.60	187	1.90	511	3.20	1,139	4.50	2,160
.70	205	2.00	547	3.30	1,200	4.60	2,260
.80	223	2.10	585	3.40	1,264	4.70	2,370
.90	242	2.20	626	3.50	1,330	4.80	2,480
1.00	262	2.30	669	3.60	1,399	4.90	2,590
1.10	282	2.40	715	3.70	1,470	5.00	2,700
1.20	304	2.50	763	3.80	1,545		
1.30	328	2.60	812	3.90	1,622		
1.40	354	2.70	862	4.00	1,700		

The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1903–4. It is well defined between gage heights 1 foot and 5 feet. Measurements above about 6 feet gage height are impossible at this station owing to the flashy character of the stream and the quantities of running ice or logs during high stages. Hence estimates above gage height 6 feet should be used with caution.

Estimated monthly discharge of Moose River at Moose River, N. Y., for 1900–1905.

[Drainage area, 346 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1900.					
June 5-30	547	140	272	0.786	0.7[illegible]
July	1,051	133	243	.702	.8[illegible]
August	547	162	251	.725	.8[illegible]
September	397	154	216	.624	.6[illegible]
October	547	162	241	.697	.8[illegible]
November	2,110	232	805	2.33	2.6[illegible]

Estimated monthly discharge of Moose River at Moose River, N. Y., for 1900–1905—Cont'd.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1901.					
April 11–30	5,880	1,277	2,623	7.58	5.64
May	2,260	773	1,229	3.55	4.09
June	3,910	374	1,437	4.15	4.63
July	1,330	256	439	1.27	1.46
August	787	218	454	1.31	1.51
September	812	346	492	1.42	1.58
October	914	333	620	1.79	2.06
November	1,023	246	417	1.21	1.35
December (26 days)	2,645	309	910	2.63	2.54
1902.					
March 21–31	4,855	1,200	2,072	5.99	2.45
April	2,700	847	1,597	4.62	5.16
May	2,760	266	912	2.64	3.04
June	1,051	450	751	2.17	2.42
July	2,370	286	634	1.83	2.11
August	1,200	227	486	1.40	1.61
September	397	191	309	.893	.996
October	1,780	266	491	1.42	1.64
November	1,080	360	589	1.70	1.90
December 1–5	763	477	611	1.77	.329
1903.					
April	5,005	511	1,648	4.76	5.31
May	511	262	324	.936	1.08
June	1,622	242	495	1.43	1.60
July	1,169	223	507	1.47	1.70
August	1,915	252	593	1.71	1.97
September	529	178	358	1.03	1.15
October	6,280	382	1,340	3.87	4.46
November	647	252	388	1.12	1.25
1904.					
April 9–30	4,705	847	2,328	6.47	5.29
May	5,400	773	1,996	5.77	6.65
June	3,180	309	858	2.48	2.77
July	888	227	445	1.29	1.49
August	1,915	246	482	1.39	1.60
September	4,050	246	887	2.56	2.86
October	2,535	634	1,266	3.66	4.22
November	1,023	467	686	1.98	2.21
1905.					
April	5,640	1,181	2,496	7.21	8.04
May	1,915	434	1,117	3.23	3.72
June	4,855	574	1,651	4.77	5.32
July	2,700	484	1,062	3.07	3.54
August	1,232	297	618	1.79	2.06
September	4,930	418	1,298	3.75	4.18
October	1,622	460	786	2.27	2.62
November	1,232	450	740	2.14	2.39
December	1,232	484	730	2.11	2.43

NOTE.—Ice conditions January 1 to April 5 1901. Ice jam took the gage out April 5, 1901. No ice in December, 1901. Gage washed out by high water December 15, 1901. River frozen: January 1 to March 17, December 6–31, 1902, January 1 to March 12, December 1–31, 1903; January 1 to April 8, December 1–31, 1904; January 1 to March 31, 1905.

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements made in Lake Ontario drainage basin by C. C. Covert, in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
June 3	Onondaga Lake outlet.	Long Branch, N. Y.	82	452	0.86	1.32	387
August 28	do	do	82	516	.78	2.22	402

ST. LAWRENCE RIVER DRAINAGE.

GENERAL FEATURES.

St. Lawrence River receives the flow of a number of New York streams having their sources in a northerly slope of the Adirondacks and fed by the innumerable lakes with which the region is dotted. Some of these rivers, as the Grass, Raquette, and St. Regis, lie entirely within the United States; others, notably Salmon, Trout, Chateaugay, and English rivers, cross the international boundary and flow northward into the St. Lawrence in Canada, as does also Richelieu River, the outlet of Lake Champlain. The following table gives a list of the principal tributaries of the St. Lawrence in the United States, with the areas drained by them:

Drainage areas of St. Lawrence River tributaries in the United States.

	Square miles.		Square miles.
Oswegatchie River	1,609	Salmon River[a]	273
Grass River	637	Trout River[b]	129
Raquette River	1,219	Chateaugay River[b]	199
St. Regis River	910	English River[b]	53
Little Salmon River[a]	103	Lake Champlain[b]	8,187

The St. Lawrence drains, through Lake Champlain, an area of 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter Creek.

CHATEAUGAY RIVER BASIN.

Chateaugay River rises in northern New York, flows northeastward, and unites with the St. Lawrence about 20 miles north of the international boundary. The river has an extensive surface in Upper and Lower Chateaugay lakes, lying on the north slope of the Adirondacks.

A measurement of the ordinary spring discharge of the stream was made by the engineers of the United States Deep Waterways Board at Ormstown, April 19, 1899. The discharge was 2,720 second-feet, or 13.6 second-feet per square mile of drainage area.

ENGLISH RIVER BASIN.

English River rises near the international boundary in the Dominion of Canada, flows southeastward into New York, and then recrosses into Canada, draining an area above the crossing of the boundary line of 53 square miles.

A measurement of the spring flow of this stream was made near the New York-Canada line on April 26, 1899, by the engineers of the United States Deep Waterways Board, at which time the discharge was 392 second-feet.

A current-meter measurement of this river was made September 1, 1905, by R. E. Horton and E. F. Weeks, at the second highway bridge south of the international boundary, 2 miles from the point where the stream crosses into Canada. The discharge was 13 second-feet; the water surface was 13.10 feet below the top of the bearing plate at the right-hand end of the bridge, downstream side.

[a] Above junction near international boundary. [b] Above New York State line.

OSWEGATCHIE RIVER BASIN.

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

Oswegatchie River has its source in the region of lakes and timbered swamps in the southern part of St. Lawrence County, N. Y. The largest of the lakes is Cranberry Lake, which affords valuable storage to water-power users on its outlet, East Branch of Oswegatchie River. East and West branches flow in a general northwesterly direction and unite near Talcville. From Gouverneur to Oxbow the river flows southwestward; it then turns sharply and flows northeastward to Rensselaer Falls, turns again to the northwest, receives the outlet of Black Lake at Galilee, and finally enters the St. Lawrence at Ogdensburg.

The gaging station was established May 16, 1903. It is located at Eel Weir Bridge, just below the junction of Oswegatchie River and Black Lake outlet.

The channel is in rock and is partly artificial, rock underneath the bridge having been removed by blasting to increase the bridge opening. The bridge consists of two spans, the right being 129.6 feet long and the left 130.1 feet.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the top of the face of the right abutment, downstream side.

A standard chain gage, which is observed twice daily by Joseph H. La Rue, is attached to the ironwork of the bridge on the upstream side of the right-hand span. The bench mark is a square chisel draft on the upstream side of the right-hand abutment; elevation, 16.72 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 360; 129, pp 118–119.
Discharge: 97, p 361; 129, p 119.
Drainage areas: 97, p 361.
Gage heights. 97, p 362; 129, p 120.

Discharge measurements of Oswegatchie River near Ogdensburg, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
March 26	Horton and Mott	269	1,200	7.70	8.02	9,237
March 26	do	269	1,226	7.35	8.15	9,014
April 14	C. C. Covert	267	1,000	7.23	7.24	7,238
April 16	do	267	975	7.10	7.12	6,926
April 17	do	267	925	6.69	6.92	6,187

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.05	4.65	4.5	10.1	5.7	5.5	6.45	5.6	5.15	4.8	5.45	5.9
2	5.3	4.65	4.5	10.05	5.7	5.45	6.5	5.7	5.05	4.8	5.4	5.95
3	6.1	4.7	4.5	9.8	5.6	5.45	6.7	5.7	5.15	4.8	5.3	6.0
4	6.75	4.7	4.5	9.55	5.6	5.35	6.7	5.7	5.25	4.8	5.3	5.9
5	6.3	4.7	4.5	9.2	5.9	5.3	6.7	5.7	5.4	4.8	5.25	5.9
6	5.75	4.7	4.5	9.1	5.9	5.3	6.6	5.65	5.5	4.8	5.2	5.9
7	5.7	4.7	4.5	8.7	6.25	5.3	6.45	5.55	5.55	4.85	5.4	5.9
8	5.7	4.7	4.5	8.35	5.95	5.5	6.25	5.4	5.6	4.9	5.45	5.9
9	5.55	4.7	4.5	8.2	5.95	5.95	6.1	5.3	5.6	4.9	5.7	5.9
10	5.3	4.7	4.5	8.05	5.9	6.0	6.05	5.35	5.6	4.9	5.75	5.75
11	5.25	4.65	4.5	7.8	5.9	6.3	5.8	5.4	5.55	4.9	5.8	5.7
12	5.3	4.6	4.5	7.5	5.9	6.35	5.7	5.4	5.4	4.8	5.9	5.7
13	5.3	4.6	4.5	7.4	5.9	6.45	5.6	5.35	5.4	5.0	5.8	5.7

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
14	5.25	4.6	4.5	7.2	5.85	6.6	5.55	5.25	5.35	5.0	5.8	5.65
15	5.2	4.6	4.5	7.2	5.9	6.6	5.4	5.1	5.3	5.2	5.9	5.45
16	5.1	4.6	4.5	7.05	5.9	6.6	5.35	5.15	5.3	5.5	5.8	5.4
17	5.0	4.6	4.5	6.9	5.9	6.6	5.3	5.35	5.2	5.5	5.6	5.4
18	5.0	4.6	4.5	6.7	5.9	6.7	5.35	5.6	5.1	5.4	5.4	5.4
19	5.0	4.6	4.7	6.7	5.9	6.7	5.25	5.9	5.1	5.4	5.4	5.35
20	5.0	4.6	5.4	6.3	5.8	6.7	5.1	6.05	5.1	5.9	5.35	5.2
21	5.0	4.6	5.6	5.95	5.9	6.7	5.1	6.1	5.1	5.7	5.3	5.1
22	5.0	4.6	5.85	6.0	5.9	6.7	5.2	6.0	5.1	5.35	5.3	5.4
23	5.0	4.5	5.95	5.85	5.9	6.65	5.2	5.75	5.1	5.45	5.3	5.55
24	5.0	4.5	6.5	5.9	5.85	6.55	5.2	5.7	5.3	5.5	5.45	5.85
25	5.0	4.5	7.2	5.95	5.75	6.4	5.25	5.65	5.3	5.5	5.35	6.15
26	5.0	4.5	7.95	5.9	5.7	6.1	5.15	5.4	5.15	5.6	5.3	6.3
27	4.95	4.5	8.85	5.85	5.7	6.2	5.2	5.4	4.9	5.6	5.3	6.4
28	4.8	4.5	9.35	5.75	5.7	6.3	5.15	5.4	4.9	5.6	5.3	6.4
29	4.75	.....	9.7	5.8	5.7	6.3	5.1	5.4	4.9	5.4	5.6	6.45
30	4.7	.....	10.05	5.75	5.6	6.4	5.1	5.35	4.9	5.4	5.7	6.5
31	4.7	.....	10.1	.....	5.5	.....	5.35	5.3	.....	5.4	.....	7.1

NOTE.—No ice at this station on account of swiftness.

RAQUETTE RIVER BASIN.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

Raquette River drains a long, narrow basin extending from northern Hamilton County to St. Lawrence River. Its sources are on an elevated plateau, dotted with mountains interspersed with lakes. The region is timbered, but numerous marsh and swamp areas exist, many of which are on the divide and feed streams flowing in opposite directions. The lakes of the headwaters afford ample opportunities for storage development.

Observations at the dam of the Hannawa Falls Power Company were taken from September, 1902, to March 31, 1903. The discharge has not been computed.

A gaging station was established at the highway bridge at Massena Springs September 21, 1903. Observations were continued until October 17, 1903, when the station was temporarily abandoned. It was resumed April 9, 1904.

The channel is straight for 300 feet above and 1,000 feet below the bridge, which consists of a single span of 167.5 feet. The banks are not subject to overflow. The current is swift and uniform.

Discharge measurements are made from the downstream side of the Massena Springs highway bridge. The initial point for soundings is the top of the right bridge abutment on the upstream side of the bridge.

The gage, which was read during 1905 by G. L. Buffum, consists of a vertical scale attached to the right abutment on the upstream side of the bridge. The bench mark is a cross painted on the outside downstream corner of the foundation adjacent to the sulphur springs; elevation above gage datum, 12.21 feet. The Sunday flow of this stream, like many others in this State, is often held back during the low-water season while ponds at mills above are being refilled. Where there is extensive pondage of this character the resultant effect may be shown in the stream for several days.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 359; 129, pp 120-121.
Discharge: 129, p 121.
Gage heights: 129, p 122.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 28 [a]	Horton and Mott	174	1,709	3.14	10.31	5,366
March 29 [a]	D. L. Mott	173	1,537	3.07	8.77	4,714
March 30 [a]	do	172	1,744	3.57	9.73	6,223
March 31 [b]	do	172	2,138	3.20	10.90	6,837
March 31	do	172	2,138	3.21	10.90	6,858
April 1 [b]	do	172	1,709	3.63	8.53	6,201
April 2	do	172	1,253	3.80	5.74	4,769
April 15	C. C. Covert	174	1,128	3.95	5.45	4,452
April 18	do	172	999	4.22	4.84	4,215
July 26	Horton and Murphy	171	723	3.20	3.15	2,310

[a] Measured through ice 2.5 feet thick.
[b] Ice gone at bridge, but backwater continued.

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	1.9	1.8	10.7	4.95	4.45	7.3	3.55	3.4	3.3	2.9	3.2
2	2.9	1.9	1.9	6.55	5.15	4.3	10.55	3.7	3.45	3.0	2.8	3.45
3	2.9	1.9	1.95	5.9	4.95	4.15	9.65	3.65	3.45	3.0	2.95	1.75
4	2.8	1.9	2.05	5.8	4.95	3.85	8.7	3.3	3.45	3.05	3.0	4.3
5	2.8	1.8	1.9	5.6	5.15	3.75	7.8	3.1	3.45	3.4	2.7	6.0
6	2.8	1.8	1.85	5.85	5.2	3.6	6.8	3.0	3.75	3.5	3.35	6.0
7	2.8	1.85	1.75	6.35	5.4	3.45	6.45	3.2	3.9	3.35	3.15	5.8
8	2.8	1.85	1.7	5.9	5.6	3.05	5.95	3.55	3.95	2.85	3.15	5.4
9	2.3	1.9	1.6	5.6	5.85	4.0	5.6	3.5	4.0	2.75	3.2	5.25
10	2.3	1.9	1.6	5.65	5.95	4.2	5.35	3.4	3.9	2.7	3.25	4.4
11	2.3	1.85	1.45	5.9	5.8	3.5	3.95	3.4	4.05	2.7	3.3	5.0
12	2.1	1.8	1.4	5.9	5.7	4.55	3.85	3.4	4.05	2.65	1.9	6.05
13	2.1	1.8	1.3	5.8	5.6	4.9	3.7	3.3	4.0	3.1	3.0	3.95
14	2.1	1.8	1.2	5.75	5.6	5.45	3.65	3.15	4.0	3.45	3.0	4.75
15	2.1	1.8	1.1	5.55	5.8	5.3	3.95	3.0	3.95	3.2	2.85	4.9
16	2.1	1.8	.95	5.4	5.95	4.7	4.05	3.2	3.9	3.3	2.95	5.1
17	2.1	1.8	1.1	5.3	6.0	4.4	4.0	4.3	3.85	3.0	3.0	4.0
18	2.1	1.8	1.2	4.75	5.9	4.85	3.6	4.6	3.8	2.8	3.05	4.1
19	2.1	1.8	1.75	4.6	5.9	5.4	4.25	4.2	4.1	2.95	2.4	3.85
20	2.0	1.85	8.25	4.5	5.9	5.35	4.4	3.95	4.3	3.1	2.85	3.8
21	1.9	1.9	7.1	4.45	5.7	6.7	4.4	3.9	4.25	3.1	3.0	4.4
22	1.9	1.9	6.0	4.5	5.3	7.35	3.9	3.55	4.0	3.05	2.1	5.0
23	1.9	1.9	6.4	4.7	4.9	7.15	3.65	3.45	3.9	3.7	2.45	5.15
24	1.9	1.9	6.55	4.75	4.85	6.75	3.4	3.4	3.85	3.3	2.55	4.35
25	1.9	1.8	7.2	4.55	4.8	6.65	3.0	3.4	3.7	2.95	2.4	5.55
26	1.9	1.9	10.4	4.5	4.75	6.5	3.05	3.3	3.65	3.1	1.75	5.5
27	1.9	1.8	11.65	4.5	4.7	6.5	3.3	3.05	3.5	3.15	3.0	5.15
28	1.9	1.8	10.05	4.45	4.75	6.85	3.15	3.0	3.55	2.95	2.75	4.85
29	1.9	.....	9.05	4.4	4.85	6.9	3.0	3.0	3.5	1.95	2.4	4.45
30	1.9	.....	10.05	4.3	4.7	6.9	3.05	3.1	3.5	2.9	2.35	4.4
31	1.9	.....	11.4	.....	4.6	.....	3.5	3.35	.....	2.9	.....	4.05

NOTE.—River frozen entirely across January 1 to March 20; March 20-31 ice going out. During frozen period the gage heights are to the water surface in a hole in the ice.

Station rating table for Raquette River at Massena Springs, N. Y., from April 9, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	190	1.80	1,140	3.60	2,675	5.40	4,420
0.10	226	1.90	1,210	3.70	2,770	5.50	4,520
0.20	265	2.00	1,285	3.80	2,865	5.60	4,620
0.30	310	2.10	1,360	3.90	2,960	5.70	4,720
0.40	355	2.20	1,435	4.00	3,055	5.80	4,820
0.50	400	2.30	1,515	4.10	3,150	5.90	4,920
0.60	445	2.40	1,595	4.20	3,245	6.00	5,020
0.70	495	2.50	1,680	4.30	3,340	6.20	5,220
0.80	545	2.60	1,770	4.40	3,435	6.40	5,420
0.90	595	2.70	1,860	4.50	3,530	6.60	5,620
1.00	650	2.80	1,950	4.60	3,625	6.80	5,820
1.10	705	2.90	2,040	4.70	3,720	7.00	6,020
1.20	760	3.00	2,130	4.80	3,820	7.20	6,220
1.30	820	3.10	2,220	4.90	3,920	7.40	6,420
1.40	880	3.20	2,310	5.00	4,020	7.60	6,620
1.50	940	3.30	2,400	5.10	4,120	7.80	6,820
1.60	1,005	3.40	2,490	5.20	4,220	8.00	7,020
1.70	1,070	3.50	2,580	5.30	4,320		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 0.1 foot and 1.9 feet; also between 5 feet and 6 feet.

Estimated monthly discharge of Raquette River at Massena Springs, N. Y., for 1904–5.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
April 9-30	5,770	3,150	4,437	3.80	3.11
May	5,270	3,388	4,257	3.64	4.20
June	4,820	910	2,694	2.30	2.57
July	2,040	265	978	.837	.965
August	1,005	310	605	.518	.597
September	2,580	650	1,011	.865	.965
October	3,150	1,995	2,580	2.21	2.55
November	3,578	1,105	2,125	1.82	2.03
December 1-9 [a]	2,400	1,175	1,964	1.68	.562
1905.					
April 2-30	5,570	3,340	4,257	3.64	3.93
May	5,020	3,625	4,349	3.72	4.29
June	6,370	2,175	4,219	3.61	4.03
July	9,570	2,130	3,929	3.36	3.87
August	3,625	2,130	2,542	2.17	2.50
September	3,340	2,490	2,869	2.45	2.73
October	2,770	1,248	2,167	1.85	2.13
November	2,445	1,105	1,943	1.66	1.85
December	5,070	1,105	3,688	3.15	3.63

[a] River frozen December 10–31, 1904.

LAKE CHAMPLAIN DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Lake Champlain occupies a long and narrow valley, extending in a north-south direction and forming a part of the boundary between New York and Vermont. The elevation of the lake is about 95 feet above tide and the water-surface area is 436 square miles.

The drainage basin is irregular in form, being about 75 miles wide from a point opposite Middlebury, Vt., northward to the outlet of the lake at Rouse Point, on the international boundary. South of Middlebury the average width of the basin is about 35 miles and the lake itself is very narrow, forming virtually a drowned river.

The tributary region is rugged and mountainous, mostly covered with forest, and with little depth of soil except in the stream valleys. The drainage is received almost entirely through large tributaries, there being little direct coast drainage into the lake. The outlet of the lake is Richelieu River, which flows northward from Rouse Point to St. Lawrence River.

In estimating the run-off from this basin in previous years the drainage area has been taken as 7,500 square miles. Maps have recently become available from which the area of the lake and its tributary drainage basin have been accurately determined, as shown in the following table:

Drainage areas tributary to Lake Champlain.

Locality.	Area.	Total area.
	Sq. miles.	*Sq. miles.*
Pike River and adjacent area in Canada	[a] 242.0	
Missisquoi River in Canada	[b] 245.0	
Land area in Canada above outlet		[a] 487.0
Missisquoi River in Vermont	[b] 615.0	
(Total Missisquoi River, 860 square miles.)		
Lamoille River	[b] 725.0	
Winooski River	[b] 995.0	
Otter Creek	[b] 935.0	
Eastern coast drainage	[b] 534.4	
Mettawee, Poultney, and Castleton rivers in Vermont	[c] 376.0	
(Castleton River, 101 square miles.)		
Land area in Vermont, except islands		4,180.4
(Poultney River, including Castleton River, [c] 265.8 square miles.)		
Wood Creek	[c] 205.0	
(Mettawee River, including Wood Creek, [c] 427.8 square miles.)		
Mettawee and Poultney rivers in New York	[c] 112.6	
Lake George outlet	220.1	
Bouquet River	[c] 268.9	
Ausable River	[d] 521.3	
Little Ausable River	[d] 75.1	
Saranac River	[d] 629.6	
Little Chazy River	[c] 63.8	
Big Chazy River	[d] 299.4	
Western coast drainage	[d] 344.6	
Land area in New York, except islands		2,740.4
Islands	[e] 55.2	55.2
Total land area above outlet		7,463.0

[a] From maps of Canadian Geological Survey. Scale: 4 miles = 1 inch.
[b] From United States post-route maps. Scale: 12.5 miles = 1 inch.
[c] From topographic maps of United States Geological Survey. Scale: 1 mile = 1 inch.
[d] From Bien's Atlas of New York. Scale: 2.5 miles = 1 inch.
[e] From charts of United States Coast and Geodetic Survey. Scale: 1:40,000.

Drainage areas tributary to Lake Champlain—Continued.

Locality.	Area.	Total area.
	Sq. miles.	*Sq. miles.*
Water surface in Canada	[a] 16.5	
Water surface in United States	[b] 419.1	
Total water surface		435.6
Total drainage above outlet		7,898.6
Richelieu River, Rouse Point to Chambly	[a] 310.0	310.0
Total drainage area above Chambly		8,208.6
Richelieu River, Chambly to mouth	[a] 626.3	626.3
(Total Richelieu River, 936.3 square miles.)		
Total drainage area above mouth		8,834.9

[a] From maps of Canadian Geological Survey. Scale: 4 miles=1 inch.
[b] From charts of United States Coast and Geodetic Survey. Scale: 1:40,000.

The land drainage area above Rouse Point is 7,463 square miles. Hence the run-off as heretofore computed represents substantially the outflow expressed as depth in inches on the land surface. As the precipitation on the lake probably exceeds the evaporation, the water surface of the lake, 436 square miles, should be added to the land area and the run-off computed for the whole drainage basin, 7,899 square miles.

The daily discharge of the lake has been determined from observations of the depth and discharge over the Chambly dam, 35 miles below the head of Richelieu River, made in 1898 by the United States Board on Deep Waterways. A rating table has been derived from the observations at the Chambly dam and the gage readings taken at Rouse Point. The area tributary to the river between Rouse Point and Chambly is 310 square miles, making the total drainage basin above Chambly 8,209 square miles.

Arrangements have been made with the Montreal Light, Heat and Power Company to obtain additional observations to corroborate the rating table.

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

A record of the height of Lake Champlain at Rouse Point, at the head of Richelieu River, the outlet of the lake, has been kept by the United States Corps of Engineers, beginning in 1875. Through the courtesy of Capt. Harry Taylor, the gage readings taken by William McComb, the fort keeper, at 9 a. m. each day are reported weekly to the United States Geological Survey.

The depth of the water is taken on a reference mark on the base of the scarp wall, at the north face of bastian B, about 3 feet from the angle with the east curtain of Fort Montgomery. This reference point is 1.50 feet above an assumed zero, and 1.50 is added to the measured depth to determine the gage reading. In winter the depth as the water rises in a hole in the ice is commonly taken. On windy days the depth is taken in a well within the fort inclosure, by measuring the depth on a flagstone in the bottom of the well.

Elevations at Fort Montgomery, N. Y.

	Feet above tide.
Elevation of reference point on scarp wall of Fort Montgomery [a]	94.948
Elevation of gage zero	93.501
Assumed high water, Lake Champlain	102.611
Assumed low water, Lake Champlain	93.361

The range of rise and fall of the lake is thus seen to be 9.25 feet, representing an available storage volume of 6.24 feet on the entire catchment area. A variation in level of 1 foot per month is equivalent to a continuous storage or draft at the rate of 4,685 second-feet.

[a] United States Deep Waterways Report, pt. 1, p. 429.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 77; 97, p 340; 129, p 125.
Discharge, daily: 82, p 78; 97, p 342; 129, pp 126-127.
Discharge, monthly: 97, p 343; 129, p 127.
Gage heights: 129, p 126.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.32	1.15	4.9	4.5	3.35	3.35	3.5	2.8	3.25	2.1	1.85
2	1.28	1.25	1.15	5.0	4.6	3.3	3.4	3.55	2.75	3.3	2.05	2.1
3	1.25	1.25	1.2	5.03	4.5	3.2	3.6	3.8	3.0	3.2	2.35	1.95
4	1.2	1.25	1.15	5.1	4.5	3.2	3.85	3.75	2.9	3.35	2.1	1.9
5	1.25	1.25	1.15	5.05	4.7	3.15	4.1	3.8	3.05	3.05	2.05	2.15
6	1.25	1.25	1.15	5.15	4.35	3.05	4.0	3.75	3.15	2.9	2.1	2.2
7	1.35	1.28	1.2	5.25	4.3	3.15	3.95	3.7	3.2	3.05	2.25	2.1
8	1.35	1.3	1.15	5.3	4.35	3.0	3.9	3.55	3.38	2.9	2.3	2.15
9	1.4	1.33	1.2	5.35	4.3	3.05	3.8	3.55	3.35	2.8	2.25	2.1
10	1.3	1.3	1.2	5.5	4.2	3.1	3.75	3.5	3.3	2.85	2.1	2.0
11	1.35	1.28	1.15	5.2	4.25	3.05	3.7	3.55	3.35	3.1	2.4	2.05
12	1.45	1.3	1.15	5.2	4.15	3.0	3.7	3.45	3.25	3.3	2.2	2.15
13	1.4	1.25	1.15	5.45	4.0	3.0	3.6	3.3	3.1	3.05	2.1	2.1
14	1.43	1.25	1.15	5.3	4.0	3.0	3.7	3.25	3.0	2.7	2.0	2.1
15	1.48	1.28	1.1	5.3	4.05	3.1	3.45	3.2	3.25	2.8	2.75	2.05
16	1.4	1.3	1.15	5.28	4.0	2.95	3.4	3.3	3.15	2.85	2.25	2.05
17	1.4	1.3	1.2	5.25	4.1	3.1	3.4	3.35	3.25	2.6	2.0	2.1
18	1.35	1.25	1.25	5.2	4.05	3.05	3.4	3.4	3.3	3.05	1.95	2.05
19	1.4	1.3	1.3	5.3	3.9	3.1	3.45	3.4	3.15	2.5	1.95	2.0
20	1.45	1.3	1.35	5.15	3.8	3.25	3.4	3.35	3.4	2.8	1.9	1.95
21	1.4	1.28	1.5	5.0	3.8	3.3	3.38	3.3	3.5	2.5	1.95	2.0
22	1.4	1.25	1.7	5.05	3.7	3.15	3.45	3.2	3.65	2.5	2.05	2.1
23	1.38	1.2	1.85	5.0	3.65	3.15	3.48	3.1	3.5	2.45	1.95	1.95
24	1.35	1.2	2.05	5.15	3.75	3.2	3.4	3.1	3.55	2.6	2.15	2.0
25	1.3	1.25	2.2	4.9	3.75	3.3	3.25	3.85	3.5	2.3	1.9	2.0
26	1.3	1.2	2.55	4.95	3.7	3.2	3.05	3.95	3.35	2.4	1.85	2.05
27	1.4	1.23	2.85	4.8	3.5	3.1	3.05	2.9	3.5	2.6	1.6	2.0
28	1.35	1.28	3.2	4.85	3.45	3.2	3.1	2.85	3.35	2.35	1.8	2.05
29	1.3	.....	3.55	5.2	3.5	3.25	2.95	2.8	3.3	2.25	2.1	2.0
30	1.33	.....	3.95	4.4	3.45	3.3	3.15	2.8	3.2	2.2	1.75	2.05
31	1.3	.....	4.45	.....	3.35	.....	3.27	2.75	.....	2.3	.....	2.1

NOTE.—February 1, lake frozen from shore to shore; ice 15 to 22 inches at different places on the lake February 10, ice 18 to 20 inches thick. February 25, top of ice 1.35 feet; thickness of ice at gage, 18 inches. March 10, top of ice, 1.25 feet; thickness of ice at gage, 23 inches. March 17, top of ice, 1.25 feet; thickness of ice at gage, 15 inches.

Station rating table for Richelieu River at Fort Montgomery, N. Y., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	3,300	1.90	9,760	3.80	16,640	5.60	24,620
.10	3,640	2.00	10,100	3.90	17,020	5.70	25,140
.20	3,980	2.10	10,440	4.00	17,400	5.80	25,660
.30	4,320	2.20	10,780	4.10	17,820	5.90	26,180
.40	4,660	2.30	11,120	4.20	18,240	6.00	26,700
.50	5,000	2.40	11,460	4.30	18,660	6.20	27,860
.60	5,340	2.50	11,800	4.40	19,080	6.40	29,020
.70	5,680	2.60	12,160	4.50	19,500	6.60	30,220
.80	6,020	2.70	12,520	4.60	19,940	6.80	31,460
.90	6,360	2.80	12,880	4.70	20,380	7.00	32,700
1.00	6,700	2.90	13,240	4.80	20,820	7.20	34,020
1.10	7,040	3.00	13,600	4.90	21,260	7.40	35,340
1.20	7,380	3.10	13,980	5.00	21,700	7.60	36,700
1.30	7,720	3.20	14,360	5.10	22,180	7.80	38,100
1.40	8,060	3.30	14,740	5.20	22,660	8.00	39,500
1.50	8,400	3.40	15,120	5.30	23,140	8.20	40,980
1.60	8,740	3.50	15,500	5.40	23,620	8.40	42,460
1.70	9,080	3.60	15,880	5.50	24,100	8.60	43,940
1.80	9,420	3.70	16,260				

The above table is based on measurements made at Chambly dam in 1898 by the U. S. Board on Deep Waterways.

Estimated monthly discharge of Richelieu River at Fort Montgomery, N. Y., for 1905.

[Drainage area, 7,750 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	8,332	7,380	7,890	1.02	1.18
February	7,822	7,380	7,608	.982	1.02
March	19,290	7,040	9,233	1.19	1.37
April	24,100	19,080	22,300	2.88	3.21
May	20,380	14,930	17,490	2.26	2.61
June	14,930	13,420	14,140	1.82	2.03
July	17,820	13,420	15,500	2.00	2.31
August	17,310	12,700	15,030	1.94	2.24
September	16,070	12,700	14,550	1.88	2.10
October	14,930	10,780	12,410	1.60	1.84
November	12,700	8,740	10,060	1.30	1.45
December	10,780	9,590	10,250	1.32	1.52
The year	24,100	7,040	13,040	1.68	22.85

NOTE.—Discharge not affected by ice conditions on the lake.

BIG CHAZY RIVER.

Big Chazy River is tributary to Lake Champlain from the New York side near the north end of the lake, a few miles below Rouse Point. The stream has two chief upper branches, which rise in the rugged, precipitous region of western Clinton County, flow in a general northeasterly direction, and unite at Mooers Forks. The flow of the branches above the junction is comparatively rapid, the descent being made in many places over smooth, sluice-like inclines. The source of the south branch is Chazy Lake, which was formerly used as a storage reservoir. Owing to the cutting of the timber and to the lower cost of iron materials, factories along the branches of this stream have gone out of business, and there are several abandoned dams.

Below Mooers Forks the main stream flows southeastward, then northeastward, and then southeastward again to the lake, a distance of 20 miles measured along its general course, descending in this distance from an elevation of 300 feet to 100 feet. The country is moderately rolling, and the river bed, which is shallow, is underlain by Potsdam sandstones. These sandstones also extend beneath the two main branches nearly to the headwaters of the stream. The soil, which covers the sandstone to a very slight depth over the greater portion of the area, is sandy and loamy, and the ground is chiefly utilized for pasturage. Numerous areas of bog and marsh exist, though the tributaries of the river are rather sparse. The conformation of the greater part of the drainage basin is conducive to moderate floods, except when influenced by ice, and to a low run-off during the dry season. A small part of the drainage area below the junction lies in Canada.

A measurement of the spring freshet discharge April 25, 1899, was made by the United States Deep Waterways engineers at Lake Champlain, 6 miles above the mouth of the stream. The discharge was found to be 1,038 second-feet, equivalent to 4 second-feet per square mile from the tributary drainage area of 257 square miles.

Current-meter measurements of the discharge in the two branches at highway bridges a few miles above the junction were made by Robert E. Horton, September 1, 1905, as follows: The south branch, at Wood Falls, discharge 74 second-feet, equivalent to 0.895 second-foot per square mile from the tributary drainage area of 83 square miles; the north branch, at bridge above Park Creek, discharge 62 second-feet, equivalent to 0.65 second-foot per square mile from a tributary drainage area of 94 square miles.

A timber dam, having an upstream face with an inclination of 4.5 horizontal to 1 vertical and a horizontal crest 125 feet long, was constructed in 1904 at Mooers Junction, on Big Chazy River. The drainage area at this point is 202.6 square miles. A gage has been placed at this dam, and the discharge has been determined as follows: Spring freshet of 1905, discharge 3,680 second-feet, or 18.1 second-feet per square mile; summer freshet of 1905, discharge 4,830 second-feet, or 23.84 second-feet per square mile. September 1, 1905, the flow at the dam was approximately 68 second-feet. The stream was very low at this date, but was not at its minimum stage.

The drainage areas tributary to the river are shown in the following table:

Drainage areas of Big Chazy River.

Point of measurement.	Area.	Total area.
	Sq. miles.	*Sq. miles.*
From entrance of Chazy Lake	.....	2.1
Above foot of Chazy Lake	.....	22.1
South branch above Wood Falls	61.0	83.1
South branch above forks	9.0	92.1
North branch above Park bridge	.....	93.7
North branch above forks	11.0	104.7
Total area at forks	.....	196.8
Mooers Forks and Mooers Junction dam	5.8	202.6
Mooers dam near mouth	96.4	299.0

SARANAC RIVER NEAR PLATTSBURG, N. Y.

Saranac River rises in southeastern Franklin County, N. Y., and flows northeastward to a point near Cadyville and thence eastward into Lake Champlain at Plattsburg. The southern boundary of the basin is the Ampersand Mountain range, and the stream drains the north slope of the most elevated region of the State of New York. About 16.2 per cent of the upper drainage area is water surface. The areas tributary to the river are shown in the following table:

Drainage areas of Saranac River.[a]

Location.	Area.	Total area.
	Sq. miles.	*Sq. miles.*
Above Saranac Lake State dam	.....	157.5
Above Saranac Lake village	44.9	202.4
Above Franklin Falls	104.3	306.7
North branch Saranac River	136.6	13[illegible]
At junction North branch	.....	4[illegible]
Above High Falls	19.6	518.4
Above Cadyville	74.6	593.0
Above Kent Falls	2.9	595.9
Above Morrisonville	2.0	597.9
Above Lozier dam	26.1	624.0
Above mouth	5.6	629.6

[a] From Bien's Atlas of New York.

In 1854 a timber dam was built below Lower Saranac Lake for the purpose of flooding logs. In 1899–1901 a masonry dam and lock were erected by the State at this point, raising the water level of Lower Saranac Lake 18 inches.

A gaging station was established at the dam of the Plattsburg Electric Light and Power Company, 6 miles above Plattsburg, March 17, 1903.

The record includes the flow over a straight spillway crest 171.25 feet in length, the discharge through two 5-foot waste gates when open, and the discharge through five 33-inch Victor turbines controlled by automatic governors. The gages are read and the record is furnished by A. E. Hare. Experiments have been made at Cornell University hydraulic laboratory on a model of the ogee section of the dam, from which coefficients have been derived for the calculation of the discharge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 355; 129, pp 128–129.
Discharge, daily: 97, p 356; 129, p 129.
Discharge, monthly: 97, p 356; 129, p 130.

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	186	337	401	2,970	1,016	943	1,604	2,543	954	558	521	702
2	800	334	490	1,720	1,129	938	3,682	1,595	924	614	731	7[illegible]
3	565	297	395	1,446	1,223	980	2,833	1,640	998	821	797	9[illegible]
4	343	234	242	1,401	1,485	1,134	2,127	1,029	1,623	835	800	7[illegible]
5	487	149	351	1,370	1,431	974	1,681	973	1,978	762	565	7[illegible]
6	270	407	462	1,468	1,389	908	1,129	716	1,838	691	867	7[illegible]
7	346	274	514	1,278	1,542	953	1,825	954	1,829	563	871	[illegible]
8	100	273	484	1,246	1,709	1,012	1,477	899	1,782	562	904	7[illegible]
9	507	268	346	1,012	1,526	1,179	1,366	800	1,636	664	1,154	7[illegible]
10	537	360	402	1,180	1,540	1,267	1,357	778	1,345	492	1,084	[illegible]
11	347	293	354	1,878	1,383	1,267	1,093	700	1,199	525	834	4[illegible]
12	277	148	187	2,033	1,222	1,627	1,128	448	999	767	715	7[illegible]

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
13	303	563	340	1,867	1,220	1,577	1,154	430	995	901	912	540
14	384	430	385	1,530	1,240	1,461	962	721	909	876	886	406
15	244	322	348	1,473	1,289	1,342	1,012	716	1,006	815	741	246
16	438	379	689	1,108	1,545	1,286	825	1,783	955	854	857	529
17	604	457	304	973	1,654	1,134	1,001	1,740	817	999	836	645
18	288	448	521	1,003	1,675	1,266	1,084	1,462	1,512	768	769	519
19	342	197	2,743	931	1,581	1,432	1,251	1,334	1,870	700	378	683
20	452	503	2,190	1,027	1,520	1,441	1,831	1,150	1,654	745	622	686
21	325	416	1,674	1,001	1,288	1,571	1,442	737	1,506	811	713	745
22	135	316	1,479	1,293	1,180	1,871	958	946	1,459	773	613	766
23	382	414	1,416	1,511	1,024	1,649	779	747	1,155	925	716	634
24	308	395	1,561	1,741	934	1,473	794	597	866	914	716	534
25	265	539	2,288	1,417	813	1,185	511	485	924	876	675	864
26	399	424	2,343	1,480	761	1,246	569	488	856	749	637	914
27	259	522	2,941	1,264	964	1,549	587	419	774	564	726	784
28	492	461	2,519	1,160	844	1,770	562	673	772	587	687	655
29	194	.....	2,932	1,340	1,006	1,627	755	656	723	317	567	595
30	455	.....	3,589	975	984	1,609	1,405	653	722	234	1,075	765
31	432	.....	4,199	.....	959	.....	4,189	991	.....	538	.....	679

Estimated monthly discharge of Saranac River near Plattsburg, N. Y., for 1905.

[Drainage area, 624 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	800	100	370	0.592	0.682
February	563	148	363	.581	.605
March	4,199	187	1,261	2.02	2.33
April	2,970	931	1,403	2.24	2.50
May	1,709	761	1,261	2.02	2.33
June	1,871	908	1,322	2.12	2.36
July	4,189	511	1,386	2.22	2.56
August	2,543	419	961	1.54	1.78
September	1,978	722	1,219	1.95	2.18
October	999	234	703	1.12	1.29
November	1,154	378	766	1.22	1.36
December	953	246	680	1.09	1.26
The year	4,199	100	975	1.56	21.24

LAKE GEORGE OUTLET AT TICONDEROGA, N. Y.

Lake George occupies a valley extending in a northeast-southwest direction, between Schroon River on the west and the south arm of Lake Champlain on the east. The lake has an average width of from 1 to 2 miles, contains numerous islands, and has precipitous, forest-covered slopes reaching to the shore on either side. The inflow is through small tributaries in deep-cut gullies on the side slopes. The lake lies at an elevation of 323 feet above tide, and the adjacent hills rise to elevations ranging between 1,200 and 2,000 feet within 1 to 2 miles of the lake margin. Outside of the main lake there is but little water surface within the drainage basin. The total area tributary to the lake above its outlet is 220 square miles, 20.5 per cent (45 square miles) of which is water surface. [a]

[a] The drainage basin of Lake George is shown on the Glens Falls, Bolton, Whitehall, Ticonderoga and adjacent topographic atlas sheets of the United States Geological Survey.

The outlet of Lake George is a stream 3 miles long, entering Lake Champlain at Fort Ticonderoga. This stream leaves Lake George at a distance of 1.5 miles from Lake Champlain and at an elevation 220 feet greater. It makes an abrupt bend, in which occur, naturally, several cascades over rock. The water power is at present developed by dams located successively along the stream, the uppermost dam controlling the outflow from Lake George.

A gaging station was established August 24, 1904, at the "B" mill of the International Paper Company at Ticonderoga. This is the second dam below Lake George.

The dam is of masonry, is without leakage, and has a horizontal crest 6 feet in breadth and substantially level.

Observations of the depth on the crest of the dam and in the tailrace are taken four times each day by C. E. Carpenter. The discharge through the turbines is determined from current-meter measurements in the tailrace below the pulp mill.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 129, United States Geological Survey, pages 133–134.

Discharge measurements of Lake George outlet[a] at Ticonderoga, N. Y., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 30	R. E. Horton	31	155	2.20	2.60	[illegible]
August 30	E. F. Weeks	31	158	2.15	2.60	[illegible]

[a] Tailrace International Paper Company's "B" mill.

Daily discharge, in second-feet, of Lake George outlet at Ticonderoga, N. Y., for 1904.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	200	255	311	235	17	.....	241	240	271	[illegible]
2	.....	193	51	313	238	18	.....	.....	242	272	[illegible]
3	.....	200	255	319	223	19	.....	193	227	247	[illegible]
4	.....	34	254	307	36	20	.....	246	223	25	[illegible]
5	.....	12	261	304	143	21	.....	251	260	198	[illegible]
6	.....	208	241	53	229	22	.....	231	242	272	[illegible]
7	.....	215	232	173	226	23	.....	260	34	268	[illegible]
8	.....	226	272	260	229	24	228	263	185	251	[illegible]
9	.....	228	84	252	214	25	194	43	302	261	[illegible]
10	.....	214	179	260	208	26	186	151	298	235	[illegible]
11	.....	31	197	258	46	27	192	255	290	34	[illegible]
12	.....	202	258	264	160	28	16	249	320	202	[illegible]
13	.....	222	235	36	193	29	205	261	275	241	[illegible]
14	.....	223	238	227	205	30	203	252	77	244	[illegible]
15	.....	229	208	336	202	31	199	.....	243	.....	[illegible]
16	.....	242	.....	283	202						

Daily discharge, in second-feet, of Lake George outlet at Ticonderoga, N. Y., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	65	193	188	348	339	438	445	445	358	84	342	[illegible]
2	136	174	182	48	522	411	119	425	349	269	314	[illegible]
3	174	172	179	315	515	442	296	438	80	353	331	[illegible]
4	173	174	177	309	521	106	80	453	.....	361	324	[illegible]
5	203	.....	70	438	514	294	302	430	229	353	41	[illegible]
6	200	176	149	438	533	430	430	70	346	355	232	[illegible]
7	221	189	169	472	100	419	438	308	349	358	321	[illegible]

Daily discharge, in second-feet, of Lake George outlet at Ticonderoga, N. Y., for 1905—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
8	84	182	167	438	355	430	449	456	342	97	328	217
9	172	179	153	53	488	449	72	415	351	292	321	260
10	223	174	177	351	512	449	224	335	80	358	328	60
11	222	185	133	497	515	84	426	434	278	353	338	190
12	205	.....	62	487	488	319	411	442	356	348	56	241
13	214	168	139	445	472	445	407	90	349	349	193	241
14	211	177	182	461	82	445	401	274	342	349	267	244
15	56	188	182	456	302	445	434	383	356	56	300	254
16	163	185	174	70	430	445	90	413	344	251	287	260
17	221	167	168	308	445	405	304	392	144	343	307	80
18	217	179	190	438	438	113	413	399	225	335	304	182
19	221	.....	60	449	438	290	438	387	360	328	56	244
20	223	165	136	462	429	434	430	70	336	324	174	247
21	213	190	174	476	94	438	434	250	349	321	214	247
22	68	182	177	487	298	408	438	356	331	75	232	244
23	153	178	182	62	446	438	70	362	355	212	244	257
24	217	182	182	333	453	450	307	362	94	307	247	60
25	212	177	215	528	434	97	430	359	269	321	273	24
26	205	70	70	524	445	286	434	367	358	317	48	180
27	223	141	164	529	438	415	442	90	362	321	185	247
28	193	185	244	515	80	423	434	245	361	311	267	241
29	.....	.....	260	495	317	426	434	350	354	46	251	254
30	151	.....	337	92	404	438	80	324	369	238	241	244
31	196	.....	361	.....	430	.....	301	349	.....	329	.....	60

Estimated monthly discharge of Lake George outlet at Ticonderoga, N. Y., for 1904–5.

[Drainage area, 220 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
August 24–31	228	16	178	0.809	0.241
September (29 days)	263	12	199	.905	.976
October (30 days)	320	34	223	1.01	1.13
November	336	25	233	1.06	1.18
December	241	36	187	.850	.980
1905.					
January (30 days)	223	56	181	.823	.949
February (25 days)	193	70	173	.786	.731
March	361	60	174	.791	.912
April	529	48	377	1.71	1.91
May	533	80	396	1.80	2.08
June	449	84	370	1.68	1.87
July	449	70	336	1.53	1.76
August	456	70	338	1.54	1.78
September (29 days)	369	80	303	1.38	1.49
October	361	46	281	1.28	1.48
November	342	41	246	1.12	1.25
December	263	24	202	.918	1.06

OTTER CREEK AT MIDDLEBURY, VT.

Otter Creek rises in the northern part of Bennington County, Vt., flows northward, and enters Lake Champlain about 6 miles northwest of Vergennes. It drains a total area of 925 square miles, all in Vermont, and of this 615 square miles are above Middlebury. Large tracts on the headwaters of the river are in forest. The slope of the river between Rutland and Middlebury is very small, but between Middlebury and the mouth it is greater. The slopes of the tributary streams are generally steep. Storage in the basin is insignificant.

A gaging station was established April 1, 1903, by H. K. Barrows. It is located at the railway bridge about one-half mile south of the railway station at Middlebury, Vt.

The channel is curved for about 300 feet above the station and straight for 200 feet below. The current is sluggish at low stages. Both banks are fairly high and do not overflow. The bed of the stream is composed of sand and gravel. The channel is constant. There is a dam 800 feet below the station, which is used for power purposes. The water, however, never falls below the crest of this dam.

Discharge measurements are made from a boat just below the railway bridge, or at the Middlebury stone-arch highway bridge just above the dam.

A standard chain gage is fastened to the lower downstream chord of the railway bridge; length of chain, 27.52 feet. During 1905 the gage was read twice each day by R. P. Bingham. The bench mark is the top of the south bolt of the bridge seat at the north abutment, downstream side; elevation, 20.08 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 353; 129, p 139.
Discharge: 97, p 353; 129, p 139.
Discharge, monthly: 97, p 355; 129, p 141.
Gage heights: 97, p 354; 129, pp 139-140.
Rating table: 97, p 354; 129, p 140.

Discharge measurements of Otter Creek at Middlebury, Vt., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29 [a]	Butterfield and Brett	120	597	6.30	15.65	3,7[illegible]
April 1 [a]	A. D. Butterfield	120	711	6.89	16.72	4,[illegible]
April 4 [a]	do.	120	768	7.24	17.22	5,[illegible]
April 10 [a]	do.	120	581	6.45	15.52	3,7[illegible]
April 10 [b]	do.	189	1,520	2.26	15.50	3,4[illegible]
May 1 [a]	Butterfield and Brett	120	367	3.73	13.40	1,[illegible]
May 12 [a]	G. M. Brett	118	334	2.83	12.90	[illegible]

[a] From arch bridge. [b] From railroad bridge.

Daily gage height, in feet, of Otter Creek at Middlebury, Vt., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	16.7	13.4	12.3	13.4	14.8	12.75	12.8	12.4	13.7
2	.....	.....	12.35	17.0	13.3	12.2	14.0	14.75	12.65	12.7	12.4	12.75
3	.....	12.2	.....	17.3	13.2	12.25	14.7	14.5	13.25	12.65	12.4	13.4
4	12.6	.....	.....	17.25	13.2	12.4	14.6	13.95	14.25	12.65	12.4	14.25
5	.....	.....	.....	16.9	13.3	12.3	14.2	13.4	14.45	12.6	12.6	14.1
6	.....	.....	.....	16.5	13.3	12.6	13.65	12.95	14.4	12.6	12.75	14.0
7	12.3	.....	.....	16.3	13.3	13.1	13.3	12.7	14.4	12.5	13.1	13.9
8	.....	.....	12.3	16.0	13.25	13.15	13.1	12.7	14.0	12.4	13.3	13.75
9	.....	12.2	.....	15.8	13.15	13.15	12.9	12.9	13.5	12.3	13.1	13.6
10	.....	.....	.....	15.55	13.2	12.9	12.7	12.8	13.05	12.3	12.9	13.3
11	.....	.....	.....	15.25	13.15	12.7	12.6	12.6	12.85	12.3	12.8	13.3
12	12.65	.....	.....	15.15	12.95	12.7	12.5	12.6	12.9	12.4	12.7	13.1
13	.....	.....	.....	15.1	12.8	12.85	12.4	12.7	13.05	12.8	12.6	13.1
14	.....	.....	.....	15.1	12.85	12.95	12.7	12.7	13.1	12.9	12.6	12.9
15	.....	.....	12.3	15.0	12.8	12.7	12.6	12.7	12.95	12.75	12.6	.....
16	.....	12.35	.....	14.9	13.05	12.5	12.4	13.0	12.8	12.65	12.5	.....
17	.....	.....	.....	14.6	13.15	12.5	12.2	13.75	12.75	12.55	12.55	.....
18	12.3	.....	.....	14.1	13.0	13.1	12.4	13.55	13.3	12.5	12.5	.....
19	.....	.....	.....	13.6	12.9	13.55	12.5	13.2	14.6	12.5	12.5	.....
20	.....	.....	.....	13.3	12.9	13.9	12.5	12.85	14.8	12.55	12.3	.....
21	.....	.....	.....	13.35	12.9	13.6	12.4	12.6	14.95	12.7	12.3	.....
22	.....	.....	.....	14.25	12.7	14.3	12.3	12.6	14.9	12.8	12.3	12.65
23	.....	12.4	.....	14.4	12.6	14.5	12.3	12.5	14.85	12.7	12.3	.....
24	.....	.....	14.15	14.1	12.5	14.45	12.0	12.45	14.6	12.65	12.3	.....
25	12.25	.....	15.0	13.8	12.4	14.0	12.3	12.4	14.2	12.6	12.3	.....
26	.....	.....	.....	13.55	12.4	13.75	12.45	12.4	13.65	12.5	12.4	.....
27	.....	.....	.....	13.4	12.55	14.5	12.5	12.3	13.4	12.5	12.45	.....
28	.....	.....	.....	13.4	12.6	14.5	12.4	12.15	13.2	12.4	12.5	.....
29	.....	.....	15.5	13.4	12.45	14.2	12.35	12.3	12.95	12.4	12.5	12.85
30	.....	.....	16.15	13.4	12.4	13.75	12.65	12.3	12.9	12.3	13.55	.....
31	.....	.....	16.6	.....	12.3	.....	14.6	12.65	.....	12.4	.....	.....

NOTE.—River frozen January 1 to March 24; clear of ice March 29, and frozen again December 15-31. During frozen season gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 4	12.6	12.7	0.8
January 7	12.3	12.35	1.1
January 12	12.65	12.65	1.0
January 18	12.3	12.3	1.0
January 25	12.25	12.4	.9
February 3	12.2	12.35	1.1
February 9	12.2	12.4	1.6
February 16	12.35	12.5	1.6
February 23	12.4	12.5	1.7
March 2	12.35	12.45	1.8
March 8	12.3	12.5	1.7
March 15	12.3	12.5	1.7

Ice began to break March 24 and went out March 29. December 22 and 29 water flowed on top of ice; ice was estimated 0.2 foot thick.

WINOOSKI RIVER AT RICHMOND, VT.

The headwaters of Winooski River lie in the Green Mountain district in the east-central part of Vermont; thence the stream flows in a general northwesterly direction into Lake Champlain near Burlington. The total area drained is 995 square miles. Considerable areas in the upper part of the basin are in forest. The storage, either artificial or natural, is insignificant.

A gaging station was established June 25, 1903, by H. K. Barrows, at the steel highway bridge one-fourth mile south of the railway station at Richmond, Vt.

The channel is straight for 100 feet above and 1,000 feet below the station and is about 175 feet wide. The banks are about 8 to 15 feet high, and overflow during very high water. The bed of the stream is of sand and rocks and is permanent. The current is medium except at low water.

Discharge measurements are made from the bridge. The initial point for soundings is at the top of the right abutment, downstream side. Gagings at low stages are made by wading at a point 2,500 feet upstream from the bridge, where the bed is of gravel and the current swift. A standard chain gage is fastened to the downstream side of the bridge: length of chain, 29.61 feet. During 1905 the gage was read twice each day by George Champang.

It is referred to bench marks as follows: On top of plate near the north end of the gage box; elevation, 28.76 feet. A marked point on the west end of the south abutment; elevation, 27.42 feet. Elevations are above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 348; 129, p 141.
Discharge: 97, p 348; 129, p 141.
Discharge, monthly: 97, p 350; 129, p 143.
Gage heights: 97, p 349; 129, p 142.
Rating table: 97, p 349; 129, p 143.

Discharge measurements of Winooski River at Richmond, Vt., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 3 [a]	H. K. Barrows	75	109	1.89	[b] 5.45	206
March 4 [c]	do	75	114	2.30	[d] 5.58	262
April 3	A. D. Butterfield	182	1,550	1.98	6.65	3,070
May 13	do	179	1,100	1.07	4.97	1,180

[a] Average thickness of ice at gaging section, 2.07 feet. Average distance from water surface to bottom of ice, 1.71 feet at gaging section.
[b] Gage height to top of ice, 5.65 feet. Ice 2.95 feet thick.
[c] Average distance water surface to bottom of ice, 1.86 feet. Average thickness of ice at gaging section, 2.23 feet.
[d] Gage height to top of ice, 5.78 feet. Ice 2.95 feet thick.

Daily gage height, in feet, of Winooski River at Richmond, Vt., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				8.6	5.8	4.9	4.7	7.95	5.7	4.7	4.8	5.3
2				7.1	5.55	4.8	8.7	6.5	5.2	4.8	5.0	5.1
3		5.3	5.5	6.55	5.6	5.45	8.9	5.55	5.1	4.8	4.85	5.5
4				6.3	6.3	5.25	6.55	5.1	8.75	4.8	4.8	6.7
5				7.45	5.9	5.1	5.8	4.85	7.25	4.7	5.0	5.7
6	5.4			7.6	5.7	6.15	5.35	4.95	6.4	4.55	4.95	5.6
7				7.3	5.7	5.8	5.1	5.1	6.2	4.5	5.4	5.5
8				6.7	5.55	5.25	4.85	4.9	5.7	4.4	5.55	5.4
9				6.3	5.5	5.15	4.65	4.8	5.25	4.4	5.2	5.4
10		5.4	5.45	6.35	5.4	4.95	4.55	4.65	4.95	4.5	5.1	5.3
11				7.2	5.2	5.2	4.65	4.5	4.8	5.9	4.9	5.15
12				7.6	5.0	5.95	4.5	4.4	4.95	5.55	4.8	.....
13	5.5			7.2	4.9	5.85	4.4	4.45	5.15	5.35	5.4	.....
14				6.8	4.9	6.3	4.5	4.2	5.0	4.95	5.65	.....
15				6.4	5.35	5.95	4.6	4.2	4.85	4.95	5.15	4.9
16				6.05	5.85	4.95	4.6	7.0	4.65	4.8	5.1	.....
17		5.3	5.7	5.9	5.55	5.1	4.95	6.45	5.05	4.7	5.2	.....
18				5.7	5.4	5.25	4.8	5.3	9.0	4.7	4.85	.....
19			11.0	5.5	5.4	4.9	4.85	4.95	9.6	5.0	4.75	.....
20	5.55		11.4	5.6	5.3	5.05	4.9	4.7	6.65	4.85	4.7	.....
21			8.8	6.7	5.15	5.35	4.55	4.65	8.05	4.7	4.6	.....
22			7.8	8.4	5.0	5.5	4.4	4.5	6.6	5.05	4.7	5.35
23			7.65	6.8	4.85	5.1	4.3	4.4	6.05	5.2	4.6	.....
24		5.25	8.05	6.4	4.7	4.8	4.2	4.3	5.6	4.9	4.6	.....
25			11.15	6.2	4.6	4.5	4.3	4.3	5.4	4.75	4.95	.....
26			9.55	6.0	4.7	4.7	4.25	4.2	5.2	4.6	5.2	.....
27	5.35		9.7	5.9	7.15	6.4	4.4	4.25	5.0	4.5	5.05	.....
28			9.8	5.95	5.9	5.65	4.4	4.45	5.1	4.5	4.9	.....
29			10.2	6.0	5.3	5.5	4.25	4.15	4.95	4.4	4.7	4.95
30			12.1	6.1	5.05	5.0	6.5	4.4	4.75	4.5	7.1	.....
31			11.45	.....	4.9	.....	10.8	6.5	.....	4.5	.....	.....

NOTE.—River frozen January 1 to about March 19 and again December 11-31. During the frozen season gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 6	5.4	5.45	1.9
January 13	5.5	5.6	2.1
January 20	5.55	5.6	2.15
January 27	5.35	5.6	2.4
February 3	5.3	5.6	2.5
February 10	5.4	5.6	2.55
February 17	5.3	5.6	2.7
February 24	5.25	5.6	2.7
March 3	5.5	5.65	3.05
March 10	5.45	5.65	3.1
March 17	5.7	5.75	2.8
December 11 [a]	.....	.....	0.1
December 15	4.9	5.25	0.7
December 22 [b]	5.35	5.05	0.95
December 29	4.95	5.15	1.1

[a] Frozen over. [b] Water flowing on top of ice.

Station rating table for Winooski River at Richmond, Vt., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.10	368	4.90	1,035	5.70	1,925	6.40	2,765
4.20	430	5.00	1,141	5.80	2,040	6.50	2,890
4.30	497	5.10	1,250	5.90	2,160	6.60	3,015
4.40	570	5.20	1,360	6.00	2,280	6.70	3,140
4.50	651	5.30	1,470	6.10	2,400	6.80	3,265
4.60	739	5.40	1,580	6.20	2,520	6.90	3,390
4.70	833	5.50	1,695	6.30	2,640	7.00	3,520
4.80	932	5.60	1,810				

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1904-5 and on form of 1904 curve. It is fairly well defined between gage heights 4.1 feet and 7.0 feet.

Estimated monthly discharge of Winooski River at Richmond, Vt., for 1905.

[Drainage area, 885 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 19-31	11,100	4,365	7,662	8.66	4.1[illegible]
April	5,670	1,695	3,065	3.46	3.[illegible]
May	3,715	739	1,589	1.80	2.[illegible]
June	2,765	651	1,515	1.71	1.91
July	9,010	430	1,542	1.74	2.[illegible]
August	4,760	399	1,202	1.36	1.5[illegible]
September	7,130	786	2,240	2.53	2.[illegible]
October	2,160	570	940	1.06	1.[illegible]
November	3,650	739	1,213	1.37	1.5[illegible]
December 1-10	3,140	1,250	1,762	1.99	0.74

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 170.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16. Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28. Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Braly Building; San Francisco, Cal., 432 Merchants' Exchange Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Great Falls, Mont.; Hazen, Nev.; Boise, Idaho; Spokane, Wash., 421 Peyton Block; Portland, Oreg.

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THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

JULY, 1906.

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Water-Supply and Irrigation Paper No. 171 Series P, Hydrographic Progress Reports, 47

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART VII.—Hudson Bay and Upper Eastern and Western Mississippi River Drainages

BY

F. W. HANNA and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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and dams or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as "equipment." These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, a boat, or by wading, and gaging stations may be classified in accordance with such use. Figure 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals varying from 2 to 20 feet, depending upon the size and conditions of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so

that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point in the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections

serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads, and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing, and a thorough knowledge of the conditions at and in the vicinity of the station.

The construction of the rating table depends upon the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

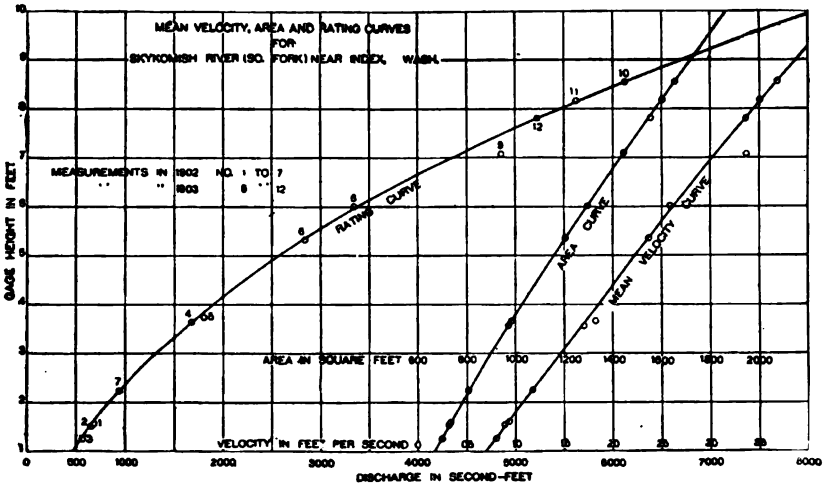

FIG. 2.—Rating, area, and mean velocity curves for South Fork Skykomish River near Index, Wash.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation, modified by gage height, or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, p. 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and to corporations who have assisted the local hydrographers in any way, either by furnishing records of the height of water or by supplying transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have aided in furnishing and preparing the data contained in this report:

Illinois.—District hydrographer, F. W. Hanna,[a] assisted by M. S. Brennan and Sidney K. Clapp. Acknowledgment is due to the Sterling Manufacturing Company for the establishment of two chain gages on the Avenue G Bridge, Sterling, Ill.

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HUDSON BAY DRAINAGE.

GENERAL FEATURES.

All the waters that reach Hudson Bay from the United States pass through Lake Winnipeg and thence into the bay through Nelson River. The two principal tributaries of Lake Winnipeg, and thus, indirectly, of Nelson River, are the Saskatchewan and Red River. The Saskatchewan drains the major portions of the provinces of Alberta and Saskatchewan and the northwestern part of Assiniboia, in the Dominion of Canada, and, through St. Mary River, a small area in northwestern Montana in the United States. Red River drains a large basin in the United States, covering portions of Minnesota and North and South Dakota. Both rivers are large and important.

ST. MARY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

St. Mary River heads in northern Montana, near the Canadian boundary line, on the eastern slope of the main range of the Rocky Mountains, in a region of perpetual snow and in the midst of numerous glaciers. It starts from the great Blackfoot Glacier, probably the largest in the Rocky Mountains within the United States, and receives affluents from at least a dozen lesser glaciers. These small streams unite within a short distance from their sources and flow into a lake hemmed in by high mountains, known as Upper St. Mary Lake. Below this lake, and separated from it by a narrow strip of land, is Lower St. Mary Lake. The aggregate length of these two lakes is about 22 miles. The river flows out of the lower lake, the elevation of which is 4,460 feet above sea level, and within 2 miles is joined by a stream nearly, if not quite, as large as itself, known as Swiftcurrent Creek, which is fed by the waters of Grinnell Glacier and four smaller glaciers. From the confluence of these streams to the international boundary, a distance of 12 miles, the St. Mary flows in a northerly direction, receiving Kennedy Creek a few miles before crossing the boundary. Entering the province of Alberta it empties into Belly River, its waters eventually finding their way through the Saskatchewan into Hudson Bay.

A canal has been constructed in Canada by the Canadian Northwest Irrigation Company to divert water from the right bank of St. Mary River about 5 miles below the international boundary line.

[a] Office of the district hydrographer for Mississippi Valley, 876-877 Federal Building, Chicago, Ill.

ST. MARY RIVER NEAR BABB, MONT.

This station was established April 9, 1902. It is located at Henry Henkel's ranch, about 1 mile east of his house, and 35 miles northwest of Browning, Mont. It is also about 4,500 feet below the foot of Lower St. Mary Lake.

The channel is straight for 500 feet above and 200 feet below the station. The right bank is high and rocky and is not liable to overflow; the left bank is comparatively low and might be overflowed by extremely high water. The bed of the stream is covered with gravel and bowlders. The velocity of the current is moderate.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is on the left bank at the middle of the cottonwood tree to which the cable is fastened.

The gage is read once daily by Henry Henkel. The original gage was of the wire type and was supported on a horizontal arm extending over the river and fastened to a cottonwood stump about 1,000 feet above the cable from which measurements were made. The length of the wire from the marker to the bottom of the weight was 11.40 feet. This was replaced on August 23, 1905, by a chain gage, 11.35 feet long. The gage is referred to bench marks as follows: (1) Spike in the foot of a cottonwood tree 30 feet north of the gage, marked "B. M. 9.24," the figures denoting elevation above gage datum. (2) A 60-penny spike in the base of a cottonwood tree 125 feet above the gage; elevation above gage datum, 9.61 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 231; 100, pp 483–484; 130, pp 20–21.
Discharge: 85, p 232; 100, p 484.
Discharge, monthly: 85, p 233; 100, p 486; 130, p 23–24.
Gage heights: 85, p 232; 100, pp 484–485; 130, pp 21–22.
Rating tables: 85, p 233; 100, p 485; 130, p 22.

Discharge measurements of St. Mary River near Babb, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	Stockman and Morse	56	79	2.51	1.85	194
May 29	H. M. Morse	96	212	3.96	3.32	840
June 18	do	100	269	5.44	4.01	1,458
July 18	A. M. Crain	97	219	4.86	3.48	1,047
July 20	H. M. Morse	95	212	4.34	3.30	922
August 11	A. M. Crain	94	163	4.07	2.92	666
September 6	do	81	109	3.14	2.11	344
September 23	Morse and Freeman	68	95	2.45	1.98	233
November 17	W. B. Freeman	.....	80	2.15	1.85	172

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2	2.0	1.8	.....	1.7	2.4	3.6	3.4	3.1	2.2	2.0	2.1	1.9
3	2.0	1.8	1.3	1.7	2.4	4.0	3.4	3.1	2.2	2.0	2.0	1.9
4	2.0	1.8	1.3	1.7	2.4	4.1	3.4	3.1	2.2	2.1	2.0	1.9
5	2.0	1.8	1.3	1.6	2.4	4.3	3.4	3.0	2.2	2.3	2.0	1.9
6	2.0	1.8	1.3	1.6	2.4	4.5	3.5	3.0	2.2	2.5	2.0	1.9
7	2.0	1.8	1.3	1.6	2.4	4.5	3.5	3.0	2.2	2.7	2.0	1.9
8	2.0	1.8	1.3	1.6	2.5	4.5	3.5	3.0	2.1	2.7	2.0	1.9
9	2.0	1.8	1.3	1.6	2.5	4.5	3.6	2.9	2.1	2.7	1.9	1.9
10	2.0	1.8	1.3	1.6	2.6	4.5	3.6	2.9	2.1	2.8	1.9	1.9
11	2.0	1.8	1.3	1.6	2.6	4.4	3.7	2.9	2.1	2.9	1.9	1.9
12	2.0	1.8	1.3	1.6	2.6	4.4	3.7	2.9	2.1	2.9	1.9	1.9
13	2.0	1.8	1.3	1.6	2.7	4.4	3.7	2.9	2.1	2.8	1.9	1.9
14	2.0	1.8	1.3	1.6	2.7	4.4	3.6	2.8	2.1	2.8	1.9	1.9
15	2.0	1.8	1.4	1.6	2.7	4.4	3.6	2.8	2.1	2.7	1.9	1.9
16	2.0	1.8	1.4	1.7	2.7	4.4	3.5	2.8	2.0	2.7	1.8	1.9
17	2.0	1.8	1.4	1.7	2.7	4.5	3.4	2.8	2.0	2.6	1.8	1.9
18	2.0	1.8	1.5	1.7	2.7	4.0	3.5	2.7	2.0	2.6	1.8	1.9
19	2.0	1.8	1.5	1.7	2.7	3.8	3.5	2.6	2.0	2.5	1.8	1.9
20	2.0	1.8	1.5	1.6	2.7	3.7	3.4	2.6	2.0	2.5	1.8	1.9
21	2.0	1.8	1.5	1.6	3.0	3.7	3.4	2.6	2.0	2.4	1.8	1.9
22	2.0	1.8	1.6	1.6	3.1	3.8	3.3	2.5	2.0	2.4	1.8	1.9
23	2.0	1.8	1.6	1.6	3.2	3.6	3.3	2.4	2.0	2.3	1.8	1.9
24	2.0	1.8	1.6	1.7	3.2	3.5	3.3	2.4	2.0	2.2	1.8	1.9
25	2.0	1.8	1.6	1.9	3.3	3.5	3.3	2.4	1.9	2.1	1.8	1.9
26	1.8	1.8	1.6	2.0	3.3	3.4	3.2	2.4	1.9	2.1	1.9	1.9
27	1.8	1.8	1.6	2.0	3.3	3.4	3.2	2.4	1.9	2.1	1.9	1.9
28	1.8	1.8	1.6	2.2	3.3	3.4	3.2	2.3	1.9	2.1	1.9	1.9
29	1.8	.....	1.7	2.4	3.3	3.3	3.2	2.3	2.0	2.1	1.9	1.9
30	1.8	.....	1.7	2.3	3.3	3.3	3.2	2.2	2.0	2.1	1.9	1.9
31	1.8	.....	1.7	.....	3.3	.....	3.2	2.2	.....	2.1	.....	1.9

NOTE.—River frozen and readings to top of ice January 1 to March 1, inclusive, and November 26 to December 31, inclusive. Ice went out March 2.

Station rating table for St. Mary River near Babb, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	45	2.50	455	3.70	1,220	4.90	2,255
1.40	65	2.60	505	3.80	1,300	5.00	2,350
1.50	90	2.70	555	3.90	1,380	5.10	2,450
1.60	115	2.80	610	4.00	1,460	5.20	2,550
1.70	145	2.90	665	4.10	1,545	5.30	2,650
1.80	175	3.00	725	4.20	1,630	5.40	2,760
1.90	210	3.10	790	4.30	1,715	5.50	2,870
2.00	245	3.20	855	4.40	1,800	5.60	2,980
2.10	285	3.30	925	4.50	1,890	5.70	3,100
2.20	325	3.40	995	4.60	1,980	5.80	3,220
2.30	365	3.50	1,070	4.70	2,070	5.90	3,340
2.40	410	3.60	1,145	4.80	2,160	6.00	3,460

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1905. It is well defined between gage heights 1.8 feet and 4 feet. The table has been extended beyond these limits. Below 1.7 feet the table is uncertain.

Estimated monthly discharge of St. Mary River near Babb, Mont., for 1905.

[Drainage area, 177 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January			[a] 45	2,767	0.254	0.293
February			[a] 40	2,221	.226	.235
March	145	45	79	4,701	.446	.514
April	410	115	161	9,580	.910	1.02
May	925	365	625	38,430	3.53	4.07
June	1,890	925	1,454	86,520	8.21	9.16
July	1,220	855	1,015	62,410	5.73	6.61
August	855	325	577	35,480	3.26	3.76
September	325	210	270	16,070	1.53	1.71
October	665	210	425	26,130	2.40	2.77
November	285	175	[a] 204	12,140	1.15	1.28
December			[a] 170	10,450	.960	1.11
The year			422	306,900	2.38	32.53

[a] Frozen period estimated.

ST. MARY RIVER NEAR CARDSTON, ALBERTA.

This station was established September 4, 1902, near Shaw's ranch, one-fourth mile north of the boundary line between the United States and Canada and 17 miles south of Cardston, Alberta.

The channel is straight for 100 yards above and 50 yards below the station. The right bank is high and not liable to overflow; the left bank is sloping and the water has been known to rise to a level considerably above the foot of the cable support. The bed of the stream is of sand and gravel and is liable to slight changes. There is but one channel, and the current is swift near the right bank.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the zero of the tagged wire at the left bank.

The gage, which is read daily by Vernon Shaw, is located at an old crossing about 1,200 feet above the cable. The gage first established was replaced in June, 1903, by the present gage. The length of the chain is 10.78 feet, and the datum is the same as that of the old gage. The gage bar is fastened to a tree and post on the left bank. The gage is referred to bench marks as follows: (1) A 60-penny spike driven into a cottonwood tree located directly back of the gage rod; elevation, 12.92 feet above zero of gage. (2) A 60-penny spike driven into a post 1 foot in diameter and 2 feet high, which is set in the ground 92 feet northeast of the gage rod; elevation, 17.56 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 225; 100, pp 476–477; 130, pp 24–25.
Discharge: 85, p 225; 100, p 477; 130, p 25.
Discharge, monthly: 100, p 479; 130, p 27.
Gage heights: 85, p 226; 100, p 478; 130, pp 25–26.
Rating table: 100, p 478; 130, p 26.

Discharge measurements of St. Mary River near Cardston, Alberta, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 27	L. R. Stockman	127	263	3.48	4.40	918
May 30	H. M. Morse	136	348	4.26	5.11	1,480
June 17	do	148	444	5.54	5.60	2,460
July 19	Morse and Crain	136	324	4.39	4.96	1,420
August 12	A. M. Crain	132	281	3.62	4.59	1,017
September 5	do	114	197	2.11	3.71	416
September 25[a]	H. M. Morse	108	166	1.96	3.53	324
November 17	W. B. Freeman	.....	160	1.59	3.30	255

[a] Made by wading.

Daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45	3.9	4.7	3.0	4.2	5.35	5.35	4.95	3.8	3.5	3.95	3.75
2	.....	3.9	.....	2.95	4.15	5.55	5.35	[a] 4.9	3.8	3.5	3.85	3.9
3	4.3	.....	3.95	[a] 2.95	4.15	5.75	5.35	4.8	3.75	[a] 4.0	3.7	3.95
4	4.05	4.15	3.65	2.95	4.1	5.9	[a] 5.3	4.7	3.7	4.6	3.7	3.8
5	4.1	4.1	3.0	2.95	4.1	6.0	5.35	[a] 4.7	3.7	4.7	[a] 3.7	3.75
6	4.05	4.15	3.0	2.95	4.1	[a] 6.0	5.35	[a] 4.6	[a] 3.7	4.85	3.65	3.8
7	4.0	4.25	3.05	3.0	4.1	6.05	5.3	4.6	[a] 3.7	4.9	3.6	3.8
8	3.7	.....	3.05	3.0	[a] 4.35	6.0	[a] 5.3	4.6	[a] 3.7	4.9	3.6	3.8
9	3.8	4.55	3.0	[a] 3.05	4.6	5.9	5.3	4.55	[a] 3.65	4.85	3.5	3.7
10	3.8	4.55	3.0	3.1	4.7	5.8	5.35	4.6	[a] 3.65	4.75	3.5	.....
11	3.8	4.55	3.0	3.1	4.65	5.8	5.35	[a] 4.6	[a] 3.65	4.65	3.5	3.65
12	3.8	4.55	[a] 3.0	[a] 3.1	4.65	5.8	5.3	4.59	3.65	4.5	[a] 3.5	3.65
13	3.9	4.55	3.0	3.15	4.6	5.85	5.3	4.5	3.65	4.5	3.45	3.65
14	.....	4.55	3.1	3.15	4.6	5.85	5.2	4.5	3.6	[a] 4.45	3.4	3.65
15	4.55	4.55	3.0	3.15	4.6	5.75	5.15	4.45	3.6	4.4	3.35	3.6
16	4.45	4.55	[a] 2.95	3.15	4.5	5.7	5.05	4.4	3.65	4.3	3.3	3.55
17	4.45	4.55	2.9	3.1	4.55	5.6	5.05	4.3	3.65	[a] 4.3	3.25	3.5
18	4.35	4.55	2.95	3.1	4.65	[a] 5.5	5.0	4.25	3.65	4.25	3.3	3.4
19	4.25	.....	2.95	3.15	4.8	5.45	4.9	4.15	3.6	4.1	3.2	3.4
20	4.25	4.6	3.0	3.2	[a] 5.0	5.35	4.85	4.05	3.6	4.0	3.15	3.35
21	4.15	4.6	2.95	3.25	5.3	5.35	4.85	4.0	3.55	3.9	3.15	3.0
22	4.0	4.65	3.0	3.25	5.35	5.55	4.85	4.0	3.4	3.85	3.15	3.0
23	4.0	4.7	2.95	3.30	5.3	5.5	4.85	4.0	3.45	3.8	3.2	2.95
24	4.15	4.7	2.95	3.50	5.15	5.4	4.85	4.0	3.5	3.8	3.2	3.05
25	4.15	.....	2.95	3.8	5.1	5.35	4.9	3.95	3.5	3.9	[a] 3.15	3.1
26	4.2	4.5	3.0	[a] 3.9	5.1	5.45	4.9	3.95	[a] 3.5	3.9	[a] 3.2	3.15
27	4.2	4.5	[a] 3.0	4.04	5.05	5.35	4.95	[a] 3.95	3.45	3.9	[a] 3.2	3.15
28	4.15	4.55	3.0	4.4	5.05	[a] 5.3	4.95	3.95	3.45	3.9	[a] 3.2	3.15
29	4.15	.....	3.0	4.3	[a] 5.1	5.25	4.9	3.95	3.5	3.9	[a] 3.2	3.15
30	4.0	.....	2.95	[a] 4.25	5.1	5.3	4.85	3.9	3.5	3.95	3.2	3.25
31	3.9	.....	2.95	.....	5.2	.....	4.85	3.9	.....	[a] 3.95	.....	3.25

[a] Interpolated gage height.

NOTE.—River frozen during January, February, and December. Readings taken as follows: To water surface in a hole in the ice January 1–13, January 19 to February 7, and December 7–31. Water flowing over ice January 15–18, February 20 to March 1, December 2–4. River frozen solid to bottom at gage February 9–18. River open but partly gorged March 3–4. River clear March 5. Readings to ice December 1, 5, and 6.

Station rating table for St. Mary River near Cardston, Alberta, from September 13, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	100	3.70	410	4.90	1,370	6.00	3,165
2.60	109	3.80	460	5.00	1,490	6.10	3,380
2.70	121	3.90	515	5.10	1,620	6.20	3,605
2.80	136	4.00	575	5.20	1,755	6.30	3,835
2.90	153	4.10	640	5.30	1,900	6.40	4,075
3.00	174	4.20	710	5.40	2,055	6.50	4,325
3.10	198	4.30	785	5.50	2,215	6.60	4,585
3.20	225	4.40	870	5.60	2,385	6.70	4,855
3.30	255	4.50	960	5.70	2,565	6.80	5,135
3.40	288	4.60	1,055	5.80	2,755	6.90	5,425
3.50	325	4.70	1,155	5.90	2,955	7.00	5,725
3.60	365	4.80	1,260				

The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1902-1905. It is well defined between gage heights 2.5 feet and 7 feet.

Estimated monthly discharge of St. Mary River near Cardston, Alberta, for 1905.

[Drainage area, 452 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January			[a] 90	5,534	0.199	0.229
February			[a] 75	4,165	.166	.173
March	198	153	[b] 171	10,510	.378	.436
April	870	163	295	17,550	.653	.729
May	1,987	640	1,215	74,710	2.69	3.10
June	3,272	1,832	2,461	146,500	5.44	6.07
July	1,987	1,315	1,642	101,000	3.63	4.18
August	1,430	515	847	52,080	1.87	2.16
September	460	288	371	22,080	.821	.916
October	1,370	325	772	47,470	.171	.197
November	545	211	298	17,730	.659	.735
December			[a] 240	14,760	.531	.612
The year			706	514,100	1.43	19.54

[a] Frozen period estimated.
[b] Mean for 27 days taken as mean for entire month.

SWIFTCURRENT CREEK NEAR BABB, MONT.

This station was established April 8, 1902. It is located one-half mile northwest of Henkel's ranch and 36 miles northwest of Browning, Mont., from which point it may be reached by regular stage. The nearest post-office is at Babb, Mont., 2 miles below.

The channel is straight for 500 feet above and 200 feet below the station. The left bank is high and rocky and not liable to overflow, though at high stages some water may pass in a small overflow channel just back of the cable support; the right bank is low and may overflow in a number of small channels which form a part of the old river bed. The bed of the stream is rocky, and the current is extremely swift during high water.

Discharge measurements are made by means of a cable, car and tagged wire, and low-water measurements are made by wading. The initial point for soundings was formerly at the left bank, but since September 2, 1904, when the cable was moved 50 yards upstream, it has been located on the right bank.

The gage is read once each day by Henry Henkel. The gage first established was washed away by high water in June, 1902, and the station was reestablished July 30, 1902. The new gage was located 1,800 feet above the first gage and above the cable station. It was again moved on September 27, 1902, to its present location, about 900 feet above the cable, as the second location was directly above a dam. The length of the wire from the marker to the end of the weight was 14.60 feet, and the distance from the zero of the rod to the outside of the pulley was 2.15 feet. This gage was washed out June 10, 1903, and replaced June 17, 1903, in practically its original position, by a gage having the same length of wire and the same position of pulley with reference to the scale zero as the former one. The length of the gage wire for the first part of 1905 was 14.57 feet. August 23, 1905, the wire was replaced by a chain, and the present chain length is 14.64 feet. The gage is referred to bench marks as follows: (1) A point chipped on a large bowlder 32.4 feet south of the gage; elevation above zero of gage, 12.52 feet. (2) Head of a 20-penny nail driven into the foot of a cottonwood tree 64.4 feet east of the gage; elevation above gage zero, 12.86 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 229; 100, pp 479–480; 130, p 28.
Discharge: 85, p. 229; 100, p 480; 130, p 29.
Discharge, monthly: 85, p 231; 100, p 482; 130, pp 30–31.
Gage heights: 85, p 230; 100, p 481; 130, p 29.
Rating tables: 85, p 230; 100, p 481; 130, p 30.

Discharge measurements of Swiftcurrent Creek near Babb, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	Stockman and Morse	57	99	5.35	3.40	530
May 29	H. M. Morse	.....	112	4.42	3.39	495
June 17	.....do	55	106	5.32	3.45	564
July 18	A. M. Crain	55	90	4.72	3.15	423
July 20	H. M. Morse	57	95	4.12	3.11	392
August 11	A. M. Crain	54	77	4.63	3.03	357
September 6	.....do	49	54	3.13	2.38	170
September 23	H. M. Morse	51	61	1.39	2.23	85
November 17	W. B. Freeman	.....	36	1.78	2.12	64

Daily gage height, in feet, of Swiftcurrent Creek near Babb, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.0	2.0	1.8	2.9	3.8	3.5	3.0	2.4	2.6	2.4	2.3
2	.....	2.0	2.1	1.8	2.9	4.0	3.5	3.0	2.4	2.9	2.4	2.3
3	.....	2.0	2.3	1.9	2.8	4.1	3.5	3.0	2.4	3.2	2.3	2.3
4	.....	2.0	2.3	1.9	2.8	4.4	3.6	3.0	2.4	3.6	2.3	2.3
5	.....	2.0	2.3	1.9	2.8	4.4	3.6	2.9	2.3	3.6	2.3	2.3
6	.....	2.0	2.3	2.0	2.7	4.4	3.6	2.9	2.3	3.5	2.2	2.3
7	.....	2.0	2.3	2.0	2.7	4.4	3.5	2.9	2.3	3.4	2.2	2.3
8	.....	2.0	2.4	2.0	2.8	4.3	3.5	2.9	2.3	3.4	2.2	2.3
9	.....	2.0	2.4	2.1	3.0	4.3	3.5	2.9	2.3	3.0	2.1	2.3
10	.....	2.0	2.4	2.2	3.0	4.2	3.5	2.9	2.3	2.9	2.1	2.3
11	.....	2.0	2.5	2.3	3.2	4.1	3.5	2.9	2.3	2.9	2.1	2.3
12	.....	2.0	2.3	2.3	3.1	3.9	3.4	2.9	2.3	2.8	2.1	2.3
13	.....	2.0	2.3	2.3	3.1	3.9	3.4	2.9	2.4	2.7	2.1	2.3
14	.....	2.0	2.1	2.3	3.1	3.8	3.3	2.9	2.3	2.7	2.1	2.3
15	.....	2.0	2.1	2.3	3.1	3.7	3.3	2.9	2.3	2.6	2.1	2.3
16	.....	2.0	2.1	2.2	3.0	3.6	3.2	2.8	2.3	2.6	2.0	2.3
17	.....	2.0	1.9	2.2	3.0	3.8	3.2	2.8	2.3	2.6	2.0	2.3
18	.....	2.0	1.9	2.2	3.2	3.3	3.1	2.7	2.3	2.5	2.0	2.3
19	.....	2.0	1.9	2.2	3.2	3.3	3.1	2.6	2.2	2.5	2.0	2.3
20	.....	2.0	1.9	2.2	3.3	3.2	3.1	2.6	2.1	2.4	2.0	2.3
21	.....	2.0	1.9	2.1	3.7	3.4	3.1	2.6	2.1	2.4	2.1	2.3
22	.....	2.0	1.9	2.1	3.7	3.3	3.1	2.5	2.0	2.4	2.1	2.3
23	.....	2.0	1.9	2.3	3.7	3.3	3.1	2.5	2.0	2.5	2.1	2.3
24	.....	2.0	1.9	2.3	3.6	3.3	3.1	2.5	2.0	2.5	2.1	2.3
25	.....	2.0	1.9	3.4	3.4	3.3	3.1	2.5	2.1	2.6	2.1	2.3
26	2.0	.....	1.9	3.6	3.4	3.3	3.1	2.5	2.1	2.6	2.3	2.3
27	2.0	1.9	1.9	3.4	3.4	3.3	3.1	2.5	2.3	2.7	2.3	2.3
28	2.0	1.9	1.9	3.1	3.4	3.3	3.1	2.5	2.3	2.7	2.3	2.3
29	2.0	.....	1.9	3.0	3.4	3.4	3.0	2.5	2.4	2.6	2.3	2.3
30	2.0	.....	1.8	2.9	3.4	3.4	3.0	2.4	2.4	2.6	2.3	2.3
31	2.0	.....	1.8	.....	3.4	.....	3.0	2.4	.....	2.5	.....	2.3

NOTE.—River frozen and readings to top of ice January 1 to February 25, inclusive, and November 26 to December 31, inclusive. Ice went out February 26.

Station rating table for Swiftcurrent Creek near Babb, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	18	2.50	160	3.20	435	3.90	875
1.90	30	2.60	190	3.30	485	4.00	950
2.00	44	2.70	225	3.40	540	4.10	1,025
2.10	60	2.80	260	3.50	600	4.20	1,100
2.20	80	2.90	300	3.60	665	4.30	1,175
2.30	105	3.00	340	3.70	730	4.40	1,255
2.40	130	3.10	385	3.80	800	4.50	1,335

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1905, and extended parallel to 1904 curve. No measurements in 1905 being above 3.5 feet. It is well defined between gage heights 2.1 feet and 3.5 feet.

Estimated monthly discharge of Swiftcurrent Creek near Babb, Mont., for 1905.

[Drainage area, 101 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 20	1,230	0.198	0.228
February	.....	.....	[a] 20	1,111	.198	.206
March	160	18	64	3,960	.638	.736
April	665	18	147	8,747	1.46	1.63
May	730	225	433	26,620	4.29	4.95
June	1,255	435	781	46,470	7.73	8.62
July	665	340	483	29,700	4.78	5.51
August	340	130	242	14,880	2.40	2.77
September	130	44	98	5,825	.969	1.08
October	665	130	276	16,970	2.73	3.15
November	130	44	[a] 66	3,957	.658	.734
December	.....	.....	[a] 50	3,074	.495	.571
The year	.....	.....	223	162,500	2.21	30.18

[a] Frozen period estimated.

KENNEDY CREEK NEAR BABB, MONT.

This station was established October 17, 1903. It is located 50 feet above the ford on the road from Altyn, Mont., to Cardston, Alberta, and is 37 miles northwest of Browning, Mont., and about 4 miles north of Babb post-office. The station is situated where the creek emerges from the canyon, about 1½ miles above its confluence with St. Mary River.

The channel is straight for 200 feet above and 100 feet below the station. The right bank is rocky and may overflow, while the left bank is high and rocky and not subject to overflow. The bed of the stream is composed of bowlders and gravel and is probably subject to change during high floods. The current is very rapid at high stages and moderate at low stages.

Discharge measurements are made by means of a cable, car, and tagged wire, and low-water measurements are made by wading. The initial point for soundings is the zero of the tagged wire on the left bank.

There is no regular observer at this station, and only occasional readings are obtained. The horizontal frame for the wire gage is bolted to a tree and post on the left bank. The gage wire was stolen in October, 1904, and gage heights for the latter part of that year and the early part of 1905 were obtained by referring the water surface to the bench mark. A new chain was installed on June 10, 1905. The length of the chain is 8.45 feet. The gage is referred to bench marks as follows: (1) A chipped point on a large bowlder at the strut near the north end of the cable; elevation above gage datum, 12.88 feet. (2) A 60-penny spike in a cottonwood tree 90 feet north of the gage; elevation, 10.49 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 482–483; 130, pp 31–32.
Discharge: 66, p 15; 100, p 483; 130, p 32.

Discharge measurements of Kennedy Creek near Babb, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 27	Stockman and Morse	51	52	1.98	6.10	103
May 29	H. M. Morse	56	63	1.92	6.19	120
June 16	do	57	75	2.95	6.35	221
July 19	Morse and Crain	56	57	2.21	6.15	126
August 11	A. M. Crain	52	44	1.75	5.96	77
September 5	do	50	38	.92	5.75	35
September 23	H. M. Morse	21	31	.89	5.65	27
November 17	W. B. Freeman		28	1.11	5.70	31

Daily gage height, in feet, of Kennedy Creek near Babb, Mont., for 1905.

Date.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				6.6		5.8		
2					6.03			
3								
4						5.75		
5					5.94	5.75		
6				6.5				
7								
8								
9					5.9			
10						5.7		
11					5.96			
12				6.4				
13			6.5					
14					5.9			
15								
16			6.4		5.9			
17								5.7
18								
19				6.15	5.85			
20								
21								
22								
23				6.1	5.8	5.65		
24			6.5					
25					5.8			
26				6.0				
27	6.1		6.6					
28					5.75			
29		6.19	6.55	6.0				
30					5.75			
31				6.05				

NOTE.—There is no regular observer at this station, gage heights being taken by members of the Geological Survey.

Station rating table for Kennedy Creek near Babb, Mont., from April to November 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.50	10	5.80	45	6.10	105	6.40	255
5.60	20	5.90	64	6.20	140	6.50	325
5.70	30	6.00	84	6.30	190		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is well defined.

Estimated monthly discharge of Kennedy Creek near Babb, Mont., for 1905.

[Drainage area, 50 square miles.]

Month.	Mean discharge in second-feet.	Total in acre-feet.	Run-off.	
			Second-feet per square mile.	Depth in inches.
January	10	615	0.200	0.231
February	10	555	.200	.206
March	30	1,845	.600	.692
April	75	4,463	1.50	1.67
May	100	6,149	2.00	2.31
June	320	19,040	6.40	7.14
July	203	12,480	4.06	4.68
August	58	3,591	1.17	1.35
September	31	1,827	.614	.685
October	30	1,845	.600	.692
November	30	1,785	.600	.669
The period		54,200		

NOTE.—By interpolating between known gage readings, monthly mean discharges have been obtained for June, July, August, and September. The monthly means for January, February, March, April, May, October, and November are estimated.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the St. Mary River basin in 1905 and show the seepage from St. Mary River.

Miscellaneous measurements in the St. Mary River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Gage height.	Area of section.	Mean velocity.	Discharge.
				Feet.	*Square feet.*	*Feet per second.*	*Second-feet.*
Sept. 23	Kennedy Creek	At mouth, Montana	16		11	2.00	22
July 20	St. Mary River	Babb, Mont.		2.30	311	4.23	1,316
Sept. 23	do	do	94	.87	138	2.30	317
Sept. 24	do	Just above mouth of Kennedy Creek, Montana.			129	2.66	343
Sept. 24	do	5½ miles below Kennedy Creek, Montana.			251	1.39	349
Sept. 24	do	Paisley dam site, Montana.			170	2.24	381
Sept. 25	do	One-fourth mile above International Line, Montana.			127	2.61	332
July 22	do	Kimball, Alberta [a]		3.35	413	3.41	1,408
Sept. 26	do	do.[b]			65	1.62	105
July 22	St. Mary canal	do.[c]			97	2.97	289
July 22	do	do.[d]			82	3.78	311
Sept. 25	do	do.[e]			98	2.84	278

[a] Measured above the head of the St. Mary canal at Canadian gaging station.
[b] Measured below the head of the St. Mary canal.
[c] Measured 2 miles below the head-gates.
[d] Measured 3 miles below the head-gates.
[e] Measured 1 mile below the head-gates.

RED RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Red River rises in Lake Traverse, on the boundary line between South Dakota and Minnesota, and flows almost due north into Lake Winnipeg, its waters finally reaching Hudson Bay through Nelson River. It drains a large area in the United States, including portions of Minnesota and of South and North Dakota.

The basin is characterized by level topography, broken in places by moraines and other glacial deposits. The greater part of it is prairie land, and its eastern half comprises some woods and a great abundance of lakes. The main river has cut a deep channel in its broad, level valley, which includes about 9,000,000 acres of excellent agricultural land, still to a large extent awaiting settlement. The heavy spring rains cause sudden freshets, which frequently entail considerable loss of life and property. The principal tributaries of the stream from the United States are Cheyenne and Pembina rivers from the west and Ottertail and Red Lake rivers from the east. Mouse River drains into it through Assiniboine River. A number of water powers have been developed during recent years on tributaries from both sides.

RED RIVER AT FARGO, N. DAK.

This station was established May 27, 1901. It is located at the bridge connecting Front street, Fargo, N. Dak., with Main street, Moorhead, Minn.

The channel is straight for about 100 feet above and 150 feet below the station. The left bank is high and steep; the right bank is low and subject to overflow at times of high water. The bed of the stream is composed of silt and mud and is fairly permanent. There is but one channel at all stages.

Discharge measurements were originally made from the bridge to which the gage is attached, but owing to unfavorable conditions for accurate measurements the measuring section was changed June 10, 1904, to the footbridge at the Fargo waterworks, one-half mile upstream from the gage, except at unusually high stages, when measurements are made from the Northern Pacific Railway bridge, 15 rods below the gage. A movable timber and stay cable, enabling the meter to be held about 7 feet horizontally upstream from the footbridge, obviates the influence of the small piling piers. This equipment is stored in the pump house of the waterworks. The initial point for soundings at the footbridge is an electric-light pole on the right bank. The initial point at the railway bridge is the right end of the draw span.

The gage, which is read by H. R. Grasse, of the United States Weather Bureau, at Moorhead, Minn., is a vertical staff attached to the east side of the breakwater for the center pier of the bridge. The zero of the gage is 44.45 feet below the top of the plank walk of the bridge over the gage. The bench mark is a point on the extreme north end of the flat top of the concrete pier of the railway bridge at the initial point for soundings; elevation above zero of gage, 37.12 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (WS=Water-Supply Paper; Bull=Bulletin):

Description: WS 85, p 237; 100, p 501; 130, pp 37-38.
Discharge: Bull 131, p 92; WS 85, p 238; 100, p 501; 130, p 38.
Discharge, monthly: WS 100, p 503; 130, p 40.
Gage heights: WS 85, p. 238; 100, pp 501-502; 130, pp 38-39.
Rating table: WS 100, p 502; 130, p 39.

Discharge measurements of Red River at Fargo, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 30	R. Richards	67	319	2.68	9.86	85[illegible]
June 22	Chandler and Richards	108	535	1.95	9.84	1,044
July 29	Chandler and Hanna	110	563	1.98	10.19	1,11[illegible]
August 22	R. Richards	114	650	2.02	10.90	1,317

Daily gage height in feet of Red River at Fargo, N. Dak., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	7.7	9.1	7.8	9.4	9.9	10.2	10.0	9.6	8.9
2	.....	7.8	8.3	7.8	9.4	9.8	10.1	10.0	9.5	8.9
3	.....	8.4	8.6	7.9	9.3	9.7	10.1	9.9	9.5	9.0
4	.....	8.6	8.5	8.1	9.3	9.6	10.0	9.9	9.5	9.0
5	.....	8.5	8.3	8.3	9.5	9.8	10.0	9.9	9.4	9.0
6	.....	8.5	8.3	8.6	9.7	9.9	10.0	9.8	9.2	9.0
7	.....	8.6	8.4	8.8	9.8	10.0	9.9	9.8	9.2	9.0
8	.....	8.6	8.5	9.0	10.0	10.1	9.8	9.8	9.1	8.9
9	.....	8.6	8.5	9.2	9.9	10.2	9.9	9.8	9.0	8.9
10	.....	8.5	8.4	9.5	9.8	10.3	9.8	9.7	9.0	8.8
11	.....	8.5	8.3	10.3	9.8	10.3	9.7	9.7	9.0	8.8
12	.....	8.5	8.3	11.4	9.7	10.3	9.8	9.7	9.1	8.7
13	.....	8.5	8.2	13.3	9.8	10.4	9.9	9.6	9.2	8.7
14	.....	8.4	8.1	15.6	9.9	10.3	10.2	9.5	9.2	8.7
15	.....	8.3	8.0	17.0	9.9	10.3	10.3	9.3	9.2	8.7
16	.....	8.2	8.0	18.0	9.9	10.2	10.4	9.3	9.2	8.8
17	.....	8.1	8.0	18.4	9.9	10.2	10.9	9.3	9.2	8.7
18	.....	8.0	8.0	17.8	9.8	10.2	11.5	9.3	9.2	8.7
19	7.6	8.0	8.0	16.7	9.7	10.2	11.4	9.4	9.2	8.7
20	.....	8.0	8.0	14.7	9.8	10.1	11.2	9.6	9.2	8.7
21	.....	8.0	8.0	13.5	9.9	10.2	11.1	9.6	9.2	8.7
22	.....	8.1	7.9	12.4	9.9	10.1	11.0	9.7	9.2	8.7
23	.....	8.1	7.9	11.7	9.9	10.0	10.8	9.8	9.2	8.7
24	.....	8.0	7.9	11.5	10.0	10.0	10.8	9.8	9.1	8.7
25	7.6	8.0	7.9	11.0	10.0	10.0	10.6	9.8	9.0	8.7
26	7.6	8.0	7.9	10.8	9.9	10.0	10.5	9.8	9.0	8.7
27	7.6	8.2	7.9	10.5	9.9	9.8	10.5	9.8	9.0	8.8
28	7.6	8.5	7.9	10.3	9.9	10.0	10.4	9.8	9.0	8.7
29	.....	9.0	7.9	10.0	10.0	10.2	10.3	9.7	9.0	8.6
30	.....	9.0	7.8	9.5	10.0	10.2	10.2	9.7	9.0	.....
31	.....	9.5	.....	9.4	.....	10.3	10.1	.....	8.9	.....

NOTE.—River frozen January 1 to March 31; also November 30 to December 31. Gage heights are to water surface in a hole in the ice.

Station rating table for Red River at Fargo, N. Dak., from January 1, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.00	225	8.80	643	10.60	1,210	12.40	1,850
7.10	244	8.90	671	10.70	1,245	12.50	1,890
7.20	263	9.00	700	10.80	1,280	12.60	1,930
7.30	283	9.10	730	10.90	1,315	12.70	1,970
7.40	304	9.20	760	11.00	1,350	12.80	2,010
7.50	325	9.30	790	11.10	1,385	12.90	2,050
7.60	347	9.40	820	11.20	1,420	13.00	2,090
7.70	369	9.50	850	11.30	1,455	13.10	2,130
7.80	392	9.60	880	11.40	1,490	13.20	2,170
7.90	415	9.70	910	11.50	1,525	13.30	2,210
8.00	439	9.80	940	11.60	1,560	13.40	2,250
8.10	463	9.90	970	11.70	1,595	13.50	2,290
8.20	488	10.00	1,000	11.80	1,630	13.60	2,330
8.30	513	10.10	1,035	11.90	1,665	13.70	2,370
8.40	538	10.20	1,070	12.00	1,700	13.80	2,410
8.50	564	10.30	1,105	12.10	1,735	13.90	2,450
8.60	590	10.40	1,140	12.20	1,770	14.00	2,490
8.70	616	10.50	1,175	12.30	1,810		

The above table is applicable only for open channel conditions. It is based on discharge measurements made during 1901–1905. It is fairly well defined between gage heights 7.2 feet and 11 feet. The table has been extended beyond these limits, being based on one high-water measurement.

Estimated monthly discharge of Red River at Fargo, N. Dak., for 1905.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	730	392	480	28,560	0.080	0.089
May	4,250	392	1,641	100,900	.274	.316
June	1,000	790	937	55,760	.156	.174
July	1,140	880	1,032	63,460	.172	.198
August	1,525	910	1,131	69,540	.188	.217
September	1,000	790	908	54,030	.151	.168
October	880	671	751	46,180	.125	.144
November 1 to 29	700	590	641	36,870	.107	.115

NOTE.—No estimate for ice period.

RED RIVER AT GRAND FORKS, N. DAK.

This station was established May 26, 1901. It is located at the Northern Pacific Railway bridge at Grand Forks, N. Dak.

The channel is straight for 500 feet above and 150 feet below the Great Northern Railway bridge. The right bank is liable to overflow at high stages and is wooded; the left bank will overflow only at very high stages and for a short distance. The water at all stages will pass beneath the four-span bridge and its trestle approaches. The current has a moderate velocity. The bed of the stream is composed of sand and mud and is subject to some change. The water is usually heavily laden with sediment from Red Lake River, which enters one-half mile above the station.

Discharge measurements are made from the Great Northern Railway bridge, about one-fifth mile above the gage. The initial point for soundings is marked in red paint on the downstream guard rail at the left end of the left span.

The original gage is a vertical staff, attached to the north end of the breakwater of the middle bridge pier. The zero of this gage was placed 5.00 feet below the zero of the United States Army Engineers' gage, which is attached to the same breakwater. A standard chain gage, which was read during 1905 by Philip Hayes, has been established with the same datum as the vertical gage and is attached to the downstream side of the bridge. The length of the chain from the end of the weight to the marker is 50.44 feet. The gage is referred to bench marks as follows: (1) North corner of iron plates of turntable near the center of the middle pier of the Northern Pacific Railway bridge, on the north side, about 1 inch above the surface of the stone pier; elevation above gage datum, 43.95 feet. (2) Spike in a telegraph pole in the lumber yard southwest of the left end of the bridge, from which it is 200 feet distant; elevation above gage datum, 48.50 feet. The top of the pulley of the chain gage is 53.12 feet above gage datum. Gage datum is 45.58 feet above the city datum of Grand Forks, and is 777.9 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 66, pp 11-12; 85, pp 235-236; 100, pp 494-495; 130, pp 40-41.
Discharge: 66, p 12; 85, p 236; 100, pp 495, 504; 130, p 41.
Discharge, monthly: 100, p 498; 130, p 43.
Gage heights: 66, p 12; 85, p 236; 100, p 496; 130, p 41.
Rating table: 100, p 497; 130, p 42.

Discharge measurements of Red River at Grand Forks, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 8	Wilcox and Turner	200	2,266	2.69	14.55	6,097
April 25	Richards and Hoskins	162	1,088	2.01	7.93	2,183
May 16	R. Richards	406	5,648	2.98	26.11	16,850
August 21	do	258	3,702	2.96	20.04	10,970

Daily gage height, in feet, of Red River at Grand Forks, N. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1			7.2	12.4	7.4	13.2	13.7	14.6	12.4	11.3	9.1
2			7.6	13.0	7.8	13.0	13.9	14.1	12.2	11.2	8.7
3			8.0	14.2	7.6	12.7	13.5	13.8	12.2	11.2	8.45
4			8.5	16.2	7.75	12.4	13.1	13.4	12.6	11.0	8.45
5			9.0	15.8	7.9	12.2	12.8	13.9	12.8	10.9	8.4
6			9.45	17.5	8.45	12.3	12.5	14.0	12.8	10.6	9.1
7	6.4		9.8	16.2	9.1	12.6	12.7	13.7	12.6	10.5	9.6
8			9.85	14.8	10.0	12.9	13.7	13.4	12.2	10.3	9.9
9			9.9	13.6	10.7	13.1	13.4	13.0	12.0	10.0	9.9
10				12.9	11.2	13.0	13.2	12.9	11.6	10.0	9.5
11				12.3	11.8	13.2	13.2	12.9	11.3	9.9	9.3
12				11.6	13.9	13.0	13.0	12.8	11.1	9.7	9.0
13				11.0	18.4	12.8	12.7	12.5	10.8	9.6	8.8
14	6.4	6.4	9.3	10.4	22.7	12.6	12.4	12.3	10.7	9.4	8.6
15				9.9	25.2	12.4	12.4	12.6	10.8	9.5	8.8
16				9.6	26.0	12.1	12.4	13.7	10.9	9.5	8.9
17				9.3	25.9	11.9	13.2	14.7	11.4	9.5	8.9
18				8.8	25.6	11.8	14.2	16.0	11.8	9.5	9.0
19				8.4	25.2	11.6	14.4	18.0	11.9	9.6	8.9
20				8.25	24.5	11.5	14.5	19.9	12.2	9.6	9.0
21	6.4	6.5	8.9	8.0	23.5	11.5	14.7	19.9	12.4	9.6	8.9
22				8.0	22.2	11.5	14.7	19.0	12.6	9.8	8.9
23				7.9	20.8	11.7	14.6	18.0	12.8	10.0	8.8
24				7.75	19.0	12.0	14.2	16.7	12.6	10.1	9.0
25				7.7	17.3	12.2	13.8	15.8	12.4	10.2	9.0
26				7.9	16.4	12.3	13.6	15.4	12.1	10.2	9.2
27		7.0		7.6	15.4	12.6	13.7	15.0	11.9	10.3	8.8
28			10.3	7.5	14.7	12.6	13.8	14.4	11.8	10.1	
29			10.9	7.65	14.2	12.7	14.0	13.8	11.5	10.1	
30			11.25	7.7	14.0	12.8	15.1	13.3	11.4	9.6	
31	6.15		11.7		13.6		15.0	12.8		9.3	

NOTE.—River frozen entirely across January 1 to March 28; March 29 to April 6 ice breaking up. Gage heights are to water surface in a hole in the ice; thickness of ice, 1.6 to 2 feet. River frozen over during December; thickness of ice, 0.4 foot to 1.9 feet.

Station rating table for Red River at Grand Forks, N. Dak., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	1,250	9.70	3,120	13.40	5,510	19.20	10,230
6.10	1,295	9.80	3,180	13.50	5,580	19.40	10,410
6.20	1,340	9.90	3,240	13.60	5,650	19.60	10,590
6.30	1,385	10.00	3,300	13.70	5,725	19.80	10,770
6.40	1,430	10.10	3,360	13.80	5,800	20.00	10,950
6.50	1,475	10.20	3,420	13.90	5,875	20.20	11,130
6.60	1,520	10.30	3,480	14.00	5,950	20.40	11,310
6.70	1,565	10.40	3,540	14.10	6,025	20.60	11,490
6.80	1,610	10.50	3,600	14.20	6,100	20.80	11,670
6.90	1,655	10.60	3,660	14.30	6,175	21.00	11,850
7.00	1,700	10.70	3,720	14.40	6,250	21.20	12,030
7.10	1,750	10.80	3,780	14.50	6,325	21.40	12,210
7.20	1,800	10.90	3,840	14.60	6,400	21.60	12,390
7.30	1,850	11.00	3,900	14.70	6,475	21.80	12,570
7.40	1,900	11.10	3,965	14.80	6,550	22.00	12,750
7.50	1,950	11.20	4,030	14.90	6,625	22.20	12,930
7.60	2,000	11.30	4,095	15.00	6,700	22.40	13,110
7.70	2,050	11.40	4,160	15.20	6,860	22.60	13,290
7.80	2,100	11.50	4,225	15.40	7,020	22.80	13,470
7.90	2,150	11.60	4,290	15.60	7,180	23.00	13,650
8.00	2,200	11.70	4,355	15.80	7,340	23.20	13,830
8.10	2,250	11.80	4,420	16.00	7,500	23.40	14,010
8.20	2,300	11.90	4,485	16.20	7,660	23.60	14,200
8.30	2,350	12.00	4,550	16.40	7,820	23.80	14,400
8.40	2,405	12.10	4,615	16.60	7,980	24.00	14,600
8.50	2,460	12.20	4,680	16.80	8,140	24.20	14,800
8.60	2,515	12.30	4,745	17.00	8,300	24.40	15,000
8.70	2,570	12.40	4,810	17.20	8,460	24.60	15,200
8.80	2,625	12.50	4,880	17.40	8,620	24.80	15,400
8.90	2,680	12.60	4,950	17.60	8,790	25.00	15,600
9.00	2,735	12.70	5,020	17.80	8,970	25.20	15,820
9.10	2,790	12.80	5,090	18.00	9,150	25.40	16,040
9.20	2,845	12.90	5,160	18.20	9,330	25.60	16,260
9.30	2,900	13.00	5,230	18.40	9,510	25.80	16,480
9.40	2,955	13.10	5,300	18.60	9,690	26.00	16,700
9.50	3,010	13.20	5,370	18.80	9,870	27.00	17,800
9.60	3,065	13.30	5,440	19.00	10,050	28.00	18,900

The above table is applicable only for open channel conditions. It is based on 24 discharge measurements made during 1901-1905. It is well defined between gage heights 6 feet and 26 feet.

Estimated monthly discharge of Red River at Grand Forks, N. Dak., for 1905.

[Drainage area, 25,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 7-30	7,660	1,950	3,288	156,500	0.127	0.113
May	16,700	1,900	8,138	500,400	.315	.363
June	5,370	4,225	4,826	287,200	.187	.209
July	6,780	4,810	5,847	259,500	.227	.262
August	10,860	4,745	6,564	403,600	.254	.293
September	5,090	3,720	4,507	268,200	.175	.195
October	4,095	2,900	3,345	205,700	.129	.149
November 1-27	3,240	2,405	2,734	151,800	.106	.106
The period				2,233,000		

NOTE.—No estimate for ice period.

OTTERTAIL RIVER NEAR FERGUS FALLS, MINN.

Ottertail River rises in Ottertail Lake, in west-central Minnesota, flows west, then south, then west, and enters Red River at Breckenridge, Minn.

The gaging station was established May 9, 1904. It is located at Three Mile Bridge, about 3½ miles northeast of Fergus Falls, Minn.

The channel is straight for about 150 feet above and 600 feet below the station. The current is medium at all stages. Both banks are high, wooded, and do not overflow. The bed of the stream is composed of clean gravel and small stones and is probably permanent except after extreme floods. There is one channel at ordinary stages, and possibly two at high water. As the chief source of supply is Ottertail Lake, sudden fluctuations in river height are not to be expected.

Discharge measurements are made from the single-span highway bridge to which the gage is attached. The initial point for soundings is the left end of the downstream hand rail.

The temporary gage, which was read during 1905 by R. G. Evensen, jr., is a vertical staff driven into the bank near the lower corner of the left abutment. The bench mark is a nail driven into the stone wing wall of the left abutment, downstream side about 4½ feet from the angle of the abutment and just behind the temporary gage; elevation above zero of gage, 5.56 feet.

A description of this station, gage height, and discharge data, and rating table are given in Water-Supply Paper No. 130, pp. 43–45.

Discharge measurements of Ottertail River near Fergus Falls, Minn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
March 31	Richards and Chandler	97	139	1.79	2.84	248
July 15	R. Richards	98	234	3.05	3.75	714
July 22	Hanna and Chandler	98	237	3.03	3.78	718

Daily gage height, in feet, of Ottertail River near Fergus Falls, Minn., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.6	2.85	3.0	3.45	3.7	3.8	3.9	3.7	3.5
2	.....	.....	2.85	3.0	3.45	3.7	3.8	3.9	3.7	3.5
3	.....	.....	2.85	3.3	3.55	3.75	3.8	3.85	3.7	3.5
4	4.0	.....	2.9	3.3	3.55	3.8	3.8	3.85	3.7	3.5
5	.....	.....	2.9	3.3	3.6	3.85	4.0	3.85	3.7	3.5
6	.....	.....	2.9	3.3	3.6	3.85	4.0	3.85	3.7	3.5
7	.....	3.2	2.95	3.3	3.6	3.9	4.0	3.8	3.7	3.5
8	.....	.....	2.95	3.3	3.6	3.85	4.0	3.8	3.7	3.5
9	.....	.....	2.95	3.3	3.6	3.85	4.0	3.8	3.7	3.5
10	.....	.....	2.8	3.3	3.6	3.8	3.95	3.8	3.65	3.5
11	.....	3.1	2.8	3.6	3.55	3.8	3.95	3.8	3.65	3.5
12	.....	3.2	2.8	3.6	3.55	3.8	3.9	3.8	3.6	3.5
13	.....	3.2	2.9	3.6	3.6	3.8	3.85	3.85	3.6	3.5
14	.....	3.2	2.9	3.6	3.6	3.8	3.85	3.85	3.6	3.5
15	.....	3.15	3.0	3.6	3.6	3.8	3.85	3.85	3.6	3.5
16	.....	3.15	3.0	3.6	3.6	3.8	3.85	3.85	3.6	2.5
17	.....	3.2	3.0	3.55	3.62	3.8	3.9	3.85	3.6	3.5
18	.....	3.2	3.0	3.55	3.6	3.8	3.9	3.95	3.55	3.5
19	.....	3.2	3.0	3.55	3.6	3.75	3.9	3.95	3.55	3.5
20	3.9	3.2	3.0	3.5	3.6	3.75	3.9	3.95	3.55	3.5
21	.....	3.15	3.0	3.5	3.6	3.75	3.9	3.9	3.55	3.5
22	.....	3.1	3.0	3.5	3.6	3.9	3.9	3.9	3.55	3.5
23	.....	3.0	3.0	3.45	3.65	3.7	3.9	3.85	3.55	3.5
24	.....	2.9	3.0	3.45	3.7	3.7	3.85	3.85	3.55	3.5
25	3.7	2.9	3.0	3.45	3.7	3.7	3.85	3.8	3.55	3.5
26	.....	2.9	3.0	3.45	3.7	3.75	3.85	3.8	3.55	3.5
27	.....	2.9	3.0	3.45	3.7	3.75	3.85	3.75	3.55	3.55
28	.....	2.9	3.0	3.45	3.7	3.8	3.85	3.75	3.55	3.6
29	.....	2.9	3.0	3.45	3.7	3.8	3.85	3.7	3.55	3.65
30	.....	2.85	3.0	3.45	3.7	3.8	3.85	3.7	3.55	.....
31	.....	2.85	.....	3.45	.....	3.8	3.85	.....	3.55	.....

NOTE.—River frozen entirely across January 1-February 28; March 1-10, ice gradually disappeared; February 14, river frozen to the bottom in the middle Gage heights are to water surface in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness.
	Feet.	*Feet.*	*Feet.*
February 14	4.0	4.3	2.4
February 20	3.9	4.2	2.2
February 25	3.7	4.0	1.7
March 1	3.6	3.6	.8

River frozen November 30 to December 31.

Station rating table for Ottertail River near Fergus Falls, Minn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	200	3.10	357	3.50	552	3.90	789
2.80	236	3.20	402	3.60	607	4.00	855
2.90	274	3.30	449	3.70	665	4.10	921
3.00	315	3.40	499	3.80	726	4.20	987

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904-5. It is well defined between gage heights 2.85 feet and 3.8 feet.

Estimated monthly discharge of Ottertail River near Fergus Falls, Minn., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 11-31	402	255	340	14,160
April	315	236	292	17,380
May	607	315	516	31,730
June	665	526	613	36,480
July	789	665	719	44,210
August	855	726	778	47,840
September	822	665	750	44,630
October	665	580	614	37,750
November 1-29	636	552	558	32,100
The period				306,300

NOTE.—No estimate for ice period.

SHEYENNE RIVER NEAR HAGGART, N. DAK.

Sheyenne River rises in the eastern part of McLean County, N. Dak., flows, in a general way, east, then south, and then northeast, and enters Red River about 12 miles north of Moorhead, Minn.

The gaging station was established March 22, 1902. It is located near the station of Haggart, on the Northern Pacific Railway, 6 miles west of Fargo, N. Dak., at a private wagon bridge about one-fourth mile north of the railroad.

The channel is straight for 30 feet above and 200 feet below the station, and the current is moderate. Both banks are steep and not liable to overflow except in unusual floods. The bed of the stream is of clay and shifts but slightly. There is one channel at all stages.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the end of the hand rail on the lower side of the bridge, right bank.

The gage, which was read during 1905 by John C. Haggart, consists of a vertical staff 17 feet long fastened to the piling pier at the middle of the bridge. The gage is referred to bench marks as follows: (1) A 12-penny nail driven into the base of the 11-inch elm tree 50 feet below the bridge on the right bank; elevation above gage zero, 17.05 feet. (2) A cross of fence staples, surrounded by brass-headed nails, on north side of 10-inch box elder tree, beside the east approach to the bridge, north side, the same being 23 feet east of the initial point for soundings; elevation above gage datum, 21.29 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 236; 100, p 498; 130, p 45.
Discharge: 85, p 236; 100, p 499; 130, p 46.
Discharge, monthly: 100, p 500; 130, p 47.
Gage heights: 85, p 237; 100, p 499; 130, p 46.
Rating table: 100, p 500; 130, p 47.

Discharge measurements of Sheyenne River near Haggart, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 30	R. Richards	53	175	1.13	6.60	198
June 22	Chandler and Richards	46	154	1.12	4.70	173
July 11	R. Richards	47	147	1.06	4.60	156
July 29	Hanna and Chandler	44	134	1.09	4.42	146
August 22	R. Richards	54	216	1.32	6.01	288

Daily gage height, in feet, of Sheyenne River near Haggart, N. Dak., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.0	5.0	4.8	4.0	4.5	3.8	.....	3.9
2	.....	4.0	5.0	4.9	4.3	4.5	3.9	.....	3.9
3	6.5	3.9	4.9	4.5	4.0	4.6	3.9	.....	.....
4	6.0	4.2	4.9	6.6	4.0	4.4	4.0	.....	.....
5	5.8	4.5	4.9	5.6	4.2	4.3	4.0	.....	.....
6	5.6	5.0	4.7	5.0	4.7	4.5	3.9	.....	.....
7	5.4	6.1	4.9	5.0	4.9	4.3	3.9	.....	.....
8	5.5	5.9	4.9	4.0	5.7	4.4	3.8	.....	.....
9	5.7	5.6	5.0	3.8	5.9	4.4	3.9	.....	4.2
10	5.7	5.8	5.0	3.9	6.0	4.3	3.8	.....	.....
11	5.6	6.1	4.9	4.5	6.2	4.2	3.6	.....	.....
12	5.5	8.7	5.4	4.7	6.3	4.2	3.6	.....	.....
13	5.4	9.8	6.1	4.5	6.2	4.1	3.7	.....	.....
14	5.3	9.3	6.0	4.5	6.5	4.2	3.6	.....	.....
15	5.0	8.0	5.7	4.4	6.4	4.3	3.6	.....	.....
16	4.8	7.5	5.5	4.5	7.0	4.2	3.5	.....	.....
17	4.6	6.9	5.4	4.5	8.2	4.1	3.5	.....	.....
18	4.6	6.5	5.3	4.3	8.8	4.0	3.6	3.6	.....
19	4.7	6.4	5.0	4.8	8.4	4.3	3.7	3.7	.....
20	4.6	6.0	4.9	5.0	7.0	4.2	3.6	3.7	.....
21	4.5	5.9	4.9	4.5	6.5	4.1	3.5	3.7	.....
22	4.4	5.8	4.6	5.0	6.0	4.2	3.6	3.7	.....
23	4.35	5.8	4.5	5.5	5.7	4.0	3.7	3.8	.....
24	4.3	5.8	4.7	5.7	5.8	3.9	3.9	3.8	.....
25	4.2	5.7	4.7	5.4	6.0	3.9	3.6	3.8	.....
26	4.3	5.6	4.7	5.0	5.9	3.8	3.6	3.8	.....
27	4.2	5.5	4.8	4.7	5.5	3.9	3.5	3.9	.....
28	4.1	5.4	5.0	4.7	5.3	3.9	3.6	3.9	.....
29	4.1	5.3	5.0	4.3	5.0	3.8	3.6	3.9	.....
30	4.1	5.4	4.8	4.3	4.9	3.7	3.5	3.9	.....
31	.....	5.4	.....	4.2	4.6	.....	3.5	.....	.....

NOTE.—River frozen over January 1 to March 31, approximately, also December 1-31.

RED LAKE RIVER AT CROOKSTON, MINN.

Red Lake River rises in Red Lake, in northeastern Clearwater County, Minn., flows in a general westerly direction, and unites with Red River at Grand Forks. The distance from source to mouth in a straight line is 105 miles; by river it is over 200 miles. The total area of the watershed is 6,518 square miles.

The gaging station was established May 19, 1901. It is located at the bridge which connects Robert and St. Paul streets, Crookston, and which is known as the "Sampson Addition" bridge. It is about one-sixth mile west of the Great Northern Railway station.

The channel is straight for 250 feet above and 200 feet below the station. The right bank is low and is covered with brush. It is liable to overflow at very high stages, but there would be very little current in the flooded section owing to the trees and brush. The left bank is high, wooded, and not liable to overflow. The bed of the stream is sandy, free from vegetation, and shifts. The current is swift.

Discharge measurements are made from the lower side of the single-span bridge at which the gages are located. The initial point for soundings is the post of the hand rail, lower side, at the left end of the bridge, at a point where the diagonal member of the bridge truss meets the floor timbers.

The gages, of which there are three, were read during 1905 by J. E. Carroll, the city engineer. The low-water vertical gage is fastened to the piling of the left abutment under the bridge; it reads from zero to 9.6 feet. The high-water vertical gage is attached to the piling of the pier at the right end of the bridge; it reads from 7.5 to 15 feet. There is also a wire gage near the middle of the bridge, having the same datum. Its horizontal scale reads from 3 to 19 feet. The dam and power house of the city waterworks are located about 1,000 feet above the gage. The opening and closing of the sluices cause some variation in the flow, but the gage readings represent a close average of the daily river height. The gages are referred to bench marks as follows: (1) Top of hydrant at corner of St. Paul and Robert streets, 30 feet south of bridge; elevation above gage datum, 24.23 feet. (2) Top of hydrant 200 feet north of bridge, at corner of St. Paul and Woodlawn streets; elevation above gage datum, 27.46 feet. The gage datum has an elevation of 825 feet above sea level. The city datum of Crookston has an elevation of 4.10 feet above gage datum. The top of the rail of the main track at the Great Northern Railway station at Crookston has an elevation of 37.63 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 66, pp 10-11; 85, pp 234-235; 100, pp 491-492; 130, p 48.
Discharge: 66, p 11; 85, p 235; 100, p 492; 130, p 49.
Discharge, monthly: 100, p 494; 130, p 50.
Gage heights: 66, p 11; 85, p 235; 100, pp 492-493; 130, p 49.
Rating table: 100, p 493; 130, p 50.

Discharge measurements of Red Lake River at Crookston, Minn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 10	Wilcox and Chandler	178	849	2.95	7.06	2,505
July 24	Hanna and Chandler	183	923	3.20	7.66	2,957
August 19	R. Richards	194	1,439	3.37	9.93	4,846

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.1	5.3	6.7	7.7	7.5	7.1	7.8	5.5	4.25
2	.....	7.25	5.25	6.45	7.0	7.45	7.2	7.7	5.5	4.1
3	.....	9.7	5.45	6.3	6.9	7.4	7.7	7.6	5.1	4.5
4	.....	9.0	5.55	6.5	6.65	8.2	8.0	7.45	5.0	4.8
5	.....	9.1	5.85	6.85	6.55	8.6	7.8	7.2	6.85	5.65
6	.....	8.9	6.2	6.85	7.05	8.2	7.6	7.0	6.65	6.65
7	.....	7.1	6.45	6.65	7.25	8.0	7.3	6.9	6.35	7.2
8	.....	6.7	6.75	6.35	7.0	7.6	7.25	6.8	6.3	6.6
9	.....	7.1	6.8	6.45	7.3	7.4	7.2	6.8	6.35	6.7
10	.....	6.8	7.05	7.0	7.0	7.4	7.15	6.7	6.2	6.4
11	.....	6.5	7.25	6.6	6.65	6.95	7.05	6.6	6.4	6.6
12	.....	6.1	9.8	6.5	6.65	6.8	6.85	6.5	6.1	6.3
13	.....	6.2	14.1	6.5	6.6	6.8	6.8	6.5	6.1	6.3
14	.....	6.05	13.2	6.25	6.55	6.8	6.65	6.5	6.0	5.9
15	.....	6.0	11.6	6.4	6.7	7.5	7.3	6.5	6.4	6.1
16	.....	5.8	10.6	5.9	8.6	7.2	8.1	6.5	6.45	6.0
17	.....	5.45	9.5	6.0	8.8	8.5	8.1	6.5	6.6	5.7
18	.....	5.4	9.6	6.55	9.2	10.0	8.2	6.4	6.15	6.0
19	.....	5.45	8.8	6.1	8.6	10.0	8.4	6.05	5.9	6.0
20	.....	4.95	8.5	5.7	9.2	9.4	8.7	5.85	6.0	6.0
21	.....	4.85	8.2	6.1	8.4	8.5	8.7	6.15	6.05	6.0
22	.....	5.0	8.0	6.05	8.2	8.2	8.4	6.85	5.9	5.5
23	.....	5.2	7.8	6.3	8.5	7.9	8.2	7.35	6.0	6.0
24	.....	5.4	7.4	6.3	7.5	7.5	8.0	6.75	6.2	5.7
25	5.2	5.1	7.4	6.55	7.15	7.2	7.9	6.9	6.5	6.0
26	5.8	5.4	7.3	6.45	7.1	7.1	7.9	6.9	6.0	6.2
27	6.4	4.9	7.0	6.5	7.2	7.1	7.9	6.65	4.75	6.0
28	6.9	5.4	6.9	6.7	8.2	7.1	7.8	6.2	4.1	6.0
29	7.4	5.35	6.95	6.75	9.3	7.0	7.8	6.1	3.85	6.0
30	7.8	4.9	6.3	7.8	8.4	6.9	7.7	6.35	4.4	6.7
31	7.0	.....	6.65	.....	7.8	6.9	.....	6.1	.....	6.65

NOTE.—River frozen entirely across January 1–March 2; March 3 to April 4 there was a gradually widening channel of open water. During December river frozen across except for narrow channel under gage.

Station rating table for Red Lake River at Crookston, Minn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	600	5.70	1,530	8.00	3,255	11.60	6,265
4.00	640	5.80	1,600	8.20	3,415	11.80	6,435
4.10	680	5.90	1,670	8.40	3,575	12.00	6,605
4.20	720	6.00	1,740	8.60	3,735	12.20	6,775
4.30	765	6.10	1,810	8.80	3,895	12.40	6,945
4.40	810	6.20	1,880	9.00	4,055	12.60	7,115
4.50	855	6.30	1,950	9.20	4,225	12.80	7,285
4.60	905	6.40	2,020	9.40	4,395	13.00	7,455
4.70	955	6.50	2,095	9.60	4,565	13.20	7,625
4.80	1,005	6.60	2,170	9.80	4,735	13.40	7,795
4.90	1,055	6.70	2,245	10.00	4,905	13.60	7,965
5.00	1,110	6.80	2,320	10.20	5,075	13.80	8,135
5.10	1,165	6.90	2,395	10.40	5,245	14.00	8,305
5.20	1,220	7.00	2,470	10.60	5,415	14.20	8,475
5.30	1,280	7.20	2,620	10.80	5,585	14.40	8,645
5.40	1,340	7.40	2,775	11.00	5,755	14.60	8,815
5.50	1,400	7.60	2,935	11.20	5,925	14.80	8,985
5.60	1,465	7.80	3,095	11.40	6,095		

The above table is applicable only for open-channel conditions. It is based on 21 discharge measurements made during 1902–1905. It is well defined between gage heights 4 feet and 11.5 feet. The table has been extended beyond these limits, being based on one measurement at gage height 18.45 feet.

Estimated monthly discharge of Red Lake River at Crookston, Minn., for 1905.

[Drainage area, 5.525 square miles.]

Month.	Discharge in second-feet.			Run-off.		
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
April	4,650	1,030	1,990	118,400	0.360	0.402
May	8,390	1,250	3,199	196,700	.579	.668
June	3,095	1,530	2,078	123,600	.376	.420
July	4,310	2,132	2,950	181,400	.534	.616
August	4,905	2,320	3,035	186,600	.549	.633
September	3,815	2,208	3,012	179,300	.545	.608
October	3,095	1,635	2,264	139,200	.410	.473
November	2,358	582	1,676	99,730	.303	.338
The period				1,225,000		

NOTE.—No estimate for ice period.

PEMBINA RIVER NEAR NECHE, N. DAK.

Pembina River rises in the southern part of Manitoba, Canada, flows in a general southeasterly direction, and unites with Red River at Pembina, N. Dak.

The gaging station was established April 29, 1903. It is located at the Great Northern Railway bridge, two-thirds of a mile north of the railroad station at Neche, N. Dak.

The channel is straight for 100 feet above and below the station. The right bank is densely wooded and the left is covered with brush. Both banks extend about 20 feet above the zero of the gage, and they are not liable to overflow except at very high stages. The bed of the stream, in which there are some sunken snags, is composed of sand and mud and may change slightly. About one-third of a mile below the gage there is a loose-rock dam 4 feet high. This raises the water 1 to 2 feet at the bridge, but as the dam is not tight the water may fall at low stages.

Discharge measurements are made from the single-span highway bridge 400 feet below the gage. The initial point for soundings is a point on the downstream hand rail, 3 feet from its right end. The bridge crosses the river obliquely, and to make allowance for this fact the hand rail has been divided into intervals of 10.4 feet. This is equivalent to 10-foot intervals of a cross section normal to the current.

The gage, which was read during 1905 by P. J. Horgan, is near the northeast corner of sec. 36, T. 164 N., R. 54 W. It consists of two sections of 1 by 6 inch plank. The lower section, reading from 0 to 5 feet, is driven into the bed of the stream, and its upper end is spiked to the bridge abutment timbers on the left bank. The upper section, reading from 5 to 24 feet, is spiked to the bridge pier on the right bank. The gage is referred to bench marks, as follows: (1) Top of horizontal timber on upstream side of right pier, near gage; it is marked with brass-headed nails and has an elevation of 23.70 feet above the zero of the gage. (2) West rail of the track at the rail joint at the crossing about 550 feet south of the gage; elevation above zero of gage, 26.54 feet. (3) Spike driven in north face of telephone pole inside the fence in the field west of the track and about 550 feet south of the gage; it is about 1½ feet above the ground and has an elevation of 24.28 feet above the zero of the gage. The elevation of the top of the 12 by 12 inch timber to which the low-water gage is fastened is 4.93 feet. The elevation of the zero of the gage above sea level, as determined by hand level from the railroad station at Neche, N. Dak., is 815 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 488–489; 130, p 51.
Discharge: 100, p 489; 130, p. 52.
Discharge, monthly: 100, p 491.
Gage heights: 100, p 490; 130, p 52.
Rating table: 100, p 490.

Discharge measurements of Pembina River near Neche, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 10	R. Richards	72	288	1.76	5.71	507
April 24	Richards and Haskins	68	208	1.03	4.30	214
July 14	R. Richards	67	187	.93	3.95	174
July 28	Hanna and Chandler	64	153	.81	3.51	124
August 20	R. Richards	64	135	.68	3.20	92

Daily gage height, in feet, of Pembina River near Neche, N. Dak., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	6.2	4.7	4.6	5.3	3.45	3.0	3.45	3.4
2	.....	6.3	4.6	4.6	5.1	3.45	3.0	3.45	3.4
3	.....	6.3	4.5	4.6	5.0	3.45	3.0	3.45	3.4
4	.....	8.2	4.4	4.6	4.9	3.45	2.95	3.5	3.45
5	.....	9.8	4.3	4.6	4.7	3.45	2.95	3.5	3.45
6	.....	9.5	4.2	4.6	4.5	3.4	3.0	3.45	3.45
7	.....	8.6	4.4	6.4	4.4	3.5	2.95	3.4	3.45
8	.....	7.5	4.8	6.2	4.4	3.6	2.95	3.45	3.45
9	.....	7.5	4.8	6.0	4.3	3.5	3.0	3.5	3.5
10	.....	7.5	5.0	9.0	4.3	3.4	3.05	3.5	3.5
11	.....	7.0	5.0	9.0	4.2	3.35	3.1	3.45	3.5
12	.....	6.5	5.9	9.0	4.1	3.3	3.15	3.5	3.5
13	.....	6.0	9.0	8.1	4.0	3.3	3.25	3.5	3.5
14	.....	5.4	8.6	6.6	4.0	3.25	3.3	3.5	3.55
15	.....	5.0	8.0	5.6	3.9	3.25	3.35	3.5	3.55
16	.....	5.0	7.4	5.3	3.9	3.25	3.35	3.5	3.5
17	.....	5.0	7.0	5.0	3.9	3.3	3.35	3.5	3.6
18	.....	5.0	6.2	5.0	3.9	3.3	3.4	3.5	3.5
19	.....	4.9	6.0	4.9	3.9	3.3	3.4	3.55	3.4
20	.....	4.9	5.8	4.9	3.9	3.25	3.35	3.55	3.3
21	.....	4.8	5.6	4.9	3.8	3.2	3.35	3.55	3.3
22	.....	4.8	5.5	5.0	3.8	3.15	3.35	3.5	3.3
23	6.0	4.8	5.3	5.0	3.8	3.1	3.35	3.5	3.3
24	6.0	4.8	5.0	4.9	3.75	3.05	3.35	3.3	3.3
25	6.1	4.8	4.8	5.1	3.7	3.0	3.3	3.4	3.25
26	6.4	4.8	4.9	5.4	3.7	3.0	3.4	3.7	3.2
27	6.7	4.8	4.9	5.5	3.6	3.0	3.4	3.5	.....
28	6.7	4.8	4.9	5.4	3.5	2.95	3.4	3.0	.....
29	6.7	4.8	4.8	5.4	3.5	2.95	3.45	3.1	.....
30	6.4	4.8	4.6	5.4	3.5	2.9	3.45	3.15	.....
31	6.4	.....	4.6	.....	3.45	2.95	.....	3.4	.....

NOTE.—River frozen over January 1 to March 22 and November 27 to December 31.

Station rating table for Pembina River near Neche, N. Dak., from February 26 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	70	4.30	233	5.60	454	6.90	714
3.10	80	4.40	248	5.70	473	7.00	735
3.20	91	4.50	263	5.80	492	7.20	777
3.30	102	4.60	279	5.90	511	7.40	919
3.40	113	4.70	295	6.00	530	7.60	862
3.50	125	4.80	311	6.10	550	7.80	906
3.60	137	4.90	328	6.20	570	8.00	950
3.70	150	5.00	345	6.30	590	8.20	994
3.80	163	5.10	363	6.40	610	8.40	1,040
3.90	176	5.20	381	6.50	630	8.60	1,086
4.00	190	5.30	399	6.60	651	8.80	1,132
4.10	204	5.40	417	6.70	672	9.00	1,180
4.20	218	5.50	435	6.80	693		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 3 feet and 4.3 feet. The table has been extended above gage height 5.7 feet.

Estimated monthly discharge of Pembina River near Neche, N. Dak., for 1905.

[Drainage area, 2,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 23-31	672	530	606	10,820	0.216	[illegible]
April	1,372	311	549	18,510	.196	[illegible]
May	1,180	218	447	27,480	.160	[illegible]
June	1,180	279	485	16,600	.173	[illegible]
July	399	119	206	12,670	.074	[illegible]
August	137	60	97	5,964	.035	[illegible]
September	119	65	93.9	5,587	.034	[illegible]
October	150	70	119	7,317	.042	[illegible]
November 1-26	137	91	116	5,982	.041	[illegible]
The period				110,900		

MOUSE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Mouse (or Souris) River rises in the southeastern part of the Province of Assiniboia, Canada, and flows southeastward to the western part of McHenry County, N. Dak., thence northeastward for about 30 miles to Towner, N. Dak., where it makes another turn to the north and northwest, which carries it back into Canada to empty into Assiniboine River, a tributary of Red River. Its drainage basin, which is limited on the southwest by the Missouri Coteau and on the northeast by the Turtle Mountains, is relatively large, but its flow is small. The region through which it flows is generally gently rolling except in the immediate vicinity of the stream, where the hills are steep and high. The chief tributary of the Mouse above Minot is Des Lacs River.

MOUSE RIVER NEAR FOXHOLM, N. DAK.

This station was established June 22, 1904. It is located at the highway bridge 3½ miles northeast of Foxholm, N. Dak., a station on the Minneapolis, St. Paul and Sault Ste. Marie Railway.

The channel is straight for about 300 feet above and 500 feet below the station. The right bank is covered with brush and overflows at extreme high water, but only for a short distance. The left bank is a clean meadow; it overflows slightly during the ordinary spring floods, and in extreme floods to a depth of several feet for a distance of nearly half a mile. The bed of the stream is composed of silt and mud and does not shift. There is but one channel at ordinary stages; during higher stages the channel is broken by two rows of piles near each end of the bridge.

Discharge measurements are made from the downstream side of the single-span bridge, to which the gage is attached. The initial point for soundings is the left end of the downstream hand rail.

A vertical staff gage, which was read during 1905 by H. Heinen, is spiked to the downstream pile of a row that supports the bridge near the left bank. The bench mark is two 12-penny nails driven into the upstream face of the pile, to which the gage is attached; elevation above zero of gage, 4.92 feet. The elevation of the zero of the gage, as determined by hand level from a Reclamation Service stake, is 1,572 feet above sea level.

A description of this station and gage-height and discharge data are given in Water-Supply Paper No. 130, pp. 32-33.

Discharge measurements of Mouse River near Foxholm, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 28	R. Richards	60	142	0.31	2.08	44
April 26 [a]	Chandler and Turner	43	41	.63	1.96	26
May 24	Richards and Chandler	64	187	.79	2.82	148
July 26 [a]	Hanna and Chandler	45	24	1.64	2.11	39
August 18 [a]	R. Richards	39	18	1.11	1.88	20

[a] Made at different sections.

Daily gage height, in feet, of Mouse River near Foxholm, N. Dak., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		3.6	2.0	2.0	2.4	2.25	2.2	2.2	1.8	1.8
2		3.6	2.0	1.9	2.4	2.2	2.2	2.2	1.8	1.8
3		3.6	2.0	2.0	2.4	2.3	2.2	2.1	1.8	1.8
4		3.7	2.0	2.1	2.4	2.3	2.2	2.0	1.8	1.8
5		3.7	1.9	2.2	2.4	2.35	2.1	2.0	1.8	1.8
6		3.7	1.8	2.1	2.4	2.4	2.1	1.9	1.8	1.8
7		3.8	1.9	2.1	2.4	2.4	2.1	1.9	1.8	1.85
8		3.9	2.0	2.1	2.45	2.45	2.1	1.8	1.8	1.9
9		4.0	2.3	2.1	2.5	2.45	2.0	1.8	1.85	1.9
10		3.9	2.1	2.2	2.5	2.45	2.0	1.7	1.9	1.9
11		3.8	2.2	2.3	2.45	2.5	1.9	1.7	1.9	1.9
12		3.8	2.3	2.4	2.4	2.55	1.9	1.6	1.9	1.9
13		3.8	2.5	2.3	2.4	2.6	1.9	1.6	1.9	1.85
14		3.8	2.3	2.35	2.3	2.6	2.1	1.6	1.9	1.85
15		3.8	2.3	2.35	2.3	2.7	2.1	1.5	1.9	1.8
16		3.7	2.2	2.4	2.3	2.7	2.0	1.5	1.9	1.8
17		3.6	2.2	2.4	2.3	2.6	2.0	1.5	1.85	1.8
18		3.5	2.2	2.4	2.3	2.5	1.9	1.5	1.8	1.75
19		3.4	2.8	2.4	2.3	2.4	1.9	1.5	1.8	1.8
20		3.3	2.4	2.4	2.3	2.3	1.9	1.5	1.8	1.8
21		3.3	2.2	2.45	2.3	2.3	1.9	1.5	1.8	1.8
22		3.2	2.0	2.45	2.3	2.2	1.8	1.5	1.7	1.9
23		3.1	2.0	2.9	2.2	2.2	1.8	1.5	1.7	1.9
24		3.0	2.2	2.8	2.2	2.2	1.8	1.5	1.7	1.9
25		2.9	2.4	2.8	2.2	2.2	1.8	1.5	1.75	1.9
26	3.6	2.8	2.7	2.7	2.4	2.2	1.8	1.6	1.8	1.9
27	3.6	2.3	2.1	2.5	2.6	2.2	1.9	1.6	1.8	1.9
28	3.6	2.2	2.1	2.45	3.3	2.2	2.5	1.6	1.8	1.9
29		2.1	2.1	2.3	3.3	2.2	2.4	1.7	1.8	
30		2.05	2.0	2.2	3.3	2.2	2.4	1.8	1.8	
31		2.1		2.2		2.2	2.3		1.8	

NOTE.—River frozen over January 1 to March 15, approximately. Thickness of ice, 3 feet. Part of the time water was over the ice. River also frozen during December.

Station rating table for Mouse River near Foxholm, N. Dak., from June 23, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	3	1.80	14	2.10	40	2.30	66
1.60	5	1.90	21	2.20	52	2.40	80
1.70	9	2.00	30				

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904-1905. It is well defined between gage heights 1.8 feet and 3 feet. Above gage height 2.4 feet the rating curve is a tangent, the difference being 14.8 per tenth. Below 1.8 feet the table is not well defined.

Estimated monthly discharge of Mouse River near Foxholm, N. Dak., for 1904-1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
June 23-30	450	324	389	[illegible]
July	384	80	197	[illegible]
August	80	52	64.4	[illegible]
September	95	55	75.7	[illegible]
October	88	66	79.2	[illegible]
November 1-19	80	52	74.8	[illegible]
The period				[illegible]
1905.				
March 16-31	273	35	157	[illegible]
April	140	13	51.7	[illegible]
May	154	21	72.0	[illegible]
June	214	52	88.9	[illegible]
July	125	52	75.6	[illegible]
August	95	14	36.4	[illegible]
September	52	3	12.6	[illegible]
October	21	9	15.3	[illegible]
November 1-28	21	12	17.4	[illegible]
The period				[illegible]

NOTE.—No estimate for ice period.

MOUSE RIVER AT MINOT, N. DAK.

This station was established May 5, 1903. It is located at the footbridge 150 feet northwest of the Great Northern Railway roundhouse at Minot N. Dak.

The channel is straight for 100 feet above and below the station. Both banks are high, covered with trees and shrubs, and will not overflow. The bed of the stream, which holds some snags and brush, is composed of sand and is fairly constant. The current has a moderate velocity.

Discharge measurements are made from the downstream side of the bridge at which the gage is located. The bridge makes an angle of 15°, with the normal to the direction of the current, and this fact must be taken into account in computing discharge measurements. The initial point for soundings is the zero mark on the downstream guard rail at the electric-light pole on the right bank.

The gage, which was read during 1905 by H. E. Wheeler, consists of a vertical staff, 20 feet long, nailed to a pile of the center pier of the bridge on the downstream side. The gage is referred to bench marks as follows: (1) Top of hydrant at the corner of the street, about 150 feet north of the gage; elevation above zero of gage, 21.83 feet. (2) Top of hydrant one block west of bench mark No. 1; elevation, 21.85 feet above zero of gage. (3) Top of rail of side track at the southwest corner of the roundhouse; elevation, 24.18 feet above zero of gage. (4) The top of the rail of the main track at the Great Northern Railway station has an elevation of 24.49 feet above the zero of the gage. As determined by connection with railroad levels, the zero of the gage has an elevation of 1,540 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 486–487; 130, p 34.
Discharge: 100, p 487; 130, p 34.
Discharge, monthly: 100, p 488.
Gage heights: 100, p 487; 130 p 34.
Rating table: 100, p 488.

Discharge measurements of Mouse River at Minot, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 27	Richards and Chandler	76	227	0.50	4.40	114
April 27	Chandler and Turner	70	195	.25	4.03	49
May 24	E. F. Chandler	77	223	.62	4.56	139
May 24[a]	do	54	89	1.36	4.45	122
July 26[a]	Hanna and Chandler	50	59	.81	4.60	48
August 18[a]	R. Richards	48	58	.62	4.01	36

[a] Made at different section.

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				4.25	4.0	4.45	4.2	4.4	4.3	3.8	3.9
2				4.25	4.0	4.45	4.2	4.4	4.3	3.8	3.9
3				4.25	4.0	4.45	4.2	4.3	4.3	3.8	3.9
4				4.25	4.05	4.45	4.2	4.3	4.25	3.8	3.9
5			4.4	4.2	4.05	4.45	4.15	4.3	4.15	3.8	3.9
6			4.4	4.2	4.05	4.45	4.15	4.3	4.15	3.8	3.9
7			4.4	4.15	4.05	4.4	4.15	4.3	4.1	3.8	3.9
8			4.35	4.15	4.05	4.4	4.15	4.25	4.0	3.8	3.9
9			4.35	4.15	4.05	4.4	4.15	4.2	4.0	3.8	3.9
10			4.3	4.15	4.05	4.4	4.15	4.15	4.0	3.8	3.9
11		4.0	4.3	4.15	4.0	4.4	4.2	4.1	4.0	3.8	3.9
12			4.3	4.15	4.0	4.4	4.3	4.0	3.9	3.8	3.9
13			4.3	4.2	4.0	4.4	4.3	4.0	3.9	3.8	3.9
14			4.3	4.2	4.0	4.35	4.35	4.2	3.9	3.8	3.9
15			4.3	4.25	4.0	4.35	4.35	4.4	3.9	3.9	3.9
16			4.3	4.25	4.0	4.3	4.35	4.4	3.9	3.9	3.9
17			4.3	4.25	4.05	4.3	4.35	4.3	3.9	3.9	3.9
18			4.3	4.25	4.05	4.3	4.4	4.2	3.9	3.9	3.9
19			4.4	4.2	4.05	4.3	4.4	4.15	3.9	3.9	4.0
20			4.4	4.2	4.05	4.3	4.4	4.15	3.8	3.9	4.0
21		4.0	4.4	4.2	4.05	4.35	4.35	4.1	3.8	3.9	4.0
22			4.4	4.15	4.1	4.35	4.35	4.1	3.8	3.9	4.0
23			4.4	4.15	4.4	4.35	4.35	4.05	3.8	3.9	4.0
24			4.4	4.1	4.45	4.3	4.35	4.0	3.8	3.9	4.0
25			4.4	4.1	4.5	4.3	4.3	4.0	3.8	3.9	4.0
26			4.4	4.0	4.5	4.3	4.3	4.0	3.8	3.9	4.0
27	4.0	4.0	4.4	4.0	4.5	4.25	4.25	4.0	3.8	3.9	4.0
28			4.35	4.0	4.5	4.25	4.2	4.0	3.8	3.9	4.0
29			4.35	4.0	4.5	4.25	4.2	4.2	3.8	3.9	.....
30			4.3	4.0	4.5	4.2	4.2	4.4	3.8	3.9	.....
31			4.25	.....	4.5	.....	4.3	4.4	.....	3.9	.....

NOTE.—River frozen over January 1 to March 4. Thickness of ice, 1 foot. Gage heights are to water surface in hole in ice. River also frozen during December.

Station rating table for Mouse River at Minot, N. Dak., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	40	4.90	202	5.80	364	6.70	526
4.10	58	5.00	220	5.90	382	6.80	544
4.20	76	5.10	238	6.00	400	6.90	562
4.30	94	5.20	256	6.10	418	7.00	580
4.40	112	5.30	274	6.20	436	7.20	620
4.50	130	5.40	292	6.30	454	7.40	660
4.60	148	5.50	310	6.40	472	7.60	700
4.70	166	5.60	328	6.50	490	7.80	740
4.80	184	5.70	346	6.60	508	8.00	780

The above table is applicable only for open channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 4 feet and 4.6 feet. The table has been extended beyond these limits. This curve is very unsatisfactory. Conditions at the station are unusual. 1904 measurements indicate a reverse in the discharge curve.

Estimated monthly discharge of Mouse River at Minot, N. Dak., for 1905.

[Drainage area, 8,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 5-31	112	85	103	5,516	.012	.012
April	85	40	68.8	4,094	.0082	.0090
May	130	40	69.3	4,261	.0082	.010
June	121	76	104	6,188	.012	.013
July	112	67	87.9	5,405	.010	.012
August	112	40	75.1	4,618	.0089	.011
September	94	4	31.3	1,862	.0037	.0041
October	22	4	13.9	855	.0017	.0020
November 1-28	40	22	28.4	1,577	.0034	.0035
The period				34,380		

DES LACS RIVER AT FOXHOLM, N. DAK.

Des Lacs River, the chief upper tributary of the Mouse, rises in the lake of the same name in northern Ward County, N. Dak., and flows southeastward, uniting with the Mouse about 10 miles above Minot.

The gaging station was established June 23, 1904. It is located at the highway bridge at Foxholm, N. Dak., a station of the Minneapolis, St. Paul and Sault Ste. Marie Railway.

The channel is straight for 75 feet above and 25 feet below the station. There is but one channel at ordinary stages. During high water it is divided by the pile piers of the bridge. The right bank is high, covered with brush, and does not overflow; the left bank is covered with brush, and at high floods the water may pass across a neck a few rods east of the bridge. The bed of the stream is composed of mud and silt and is slightly shifting. The current is sluggish at low stages.

Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is the right end of the downstream hand rail.

A staff gage, which was read during 1905 by Thomas H. Kinney, is nailed to the downstream side of the first pier from the left bank. The pier is composed of rows of piles parallel to the bank of the stream. The gage is referred to bench marks as follows: (1) Group of four spikes driven into the pile beside the gage rod; elevation above zero of gage, 10.00 feet. (2) Cluster of nails driven flush in the center of the top of a 12-inch post standing about 1 foot high, located approximately 34 feet south and 350 west of the southwest corner of bridge floor and hand rail; elevation above gage zero, 20.53 feet. (3) Top of rail of main track of "Soo" Railway at road crossing about 500 feet southwest of bridge. Elevation of zero of gage, as obtained by hand level from the railroad, is 1,633 feet above sea level.

A description of his station, gage height and discharge data, and rating table are given in Water-Supply Paper No. 130, pp. 35-37.

Discharge measurements of Des Lacs River at Foxholm, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 28	R. Richards	17	30	0.32	2.64	9.5
April 26	E. F. Chandler	14	5	.57	1.98	2.9
May 24	R. Richards	14	6	.77	2.04	4.5
July 26	Hanna and Chandler	12	3	1.49	2.45	4.[illegible]
August 18 [a]	R. Richards	12	3	.80	2.02	2.5

[a] Made at different section.

Daily gage height, in feet, of Des Lacs River at Foxholm, N. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			3.7	2.35	1.95	1.9	1.8	2.0	1.85	1.8	1.75	1.9
2			3.6	2.3	1.95	1.9	1.8	9.0	1.85	1.8	1.75	1.9
3			3.4	2.25	1.95	1.9	1.8	4.5	1.8	1.8	1.75	1.9
4		2.3	3.2	2.25	1.95	1.9	1.8	3.1	1.8	1.8	1.75	1.9
5			3.5	2.25	1.95	1.95	1.75	3.0	1.8	1.8	1.75	1.9
6			3.3	2.2	2.0	2.0	1.75	3.0	1.8	1.8	1.8	1.9
7	2.3		3.2	2.2	1.95	2.5	1.75	3.0	1.8	1.8	1.9	1.9
8			3.2	2.2	1.95	2.1	1.75	2.7	1.8	1.8	2.0	1.9
9			2.8	2.2	1.95	2.15	1.75	2.7	1.8	1.8	2.0	1.9
10			2.9	2.2	1.95	2.2	1.75	2.65	1.8	1.8	2.0	1.9
11		2.3	3.0	2.1	2.0	2.2	1.75	2.5	1.8	1.8	2.0	1.9
12			3.0	2.1	2.1	2.15	1.75	2.5	1.8	1.8	2.0	1.9
13		2.3		2.1	2.1	2.15	1.75	2.5	1.8	1.8	2.0	1.9
14	2.3			2.0	2.1	2.1	3.8	2.5	1.8	1.8	1.95	1.9
15			3.0	2.0	2.1	2.1	3.6	2.4	1.8	1.8	1.95	1.9
16				2.0	2.1	2.1	2.0	2.3	1.8	1.8	1.95	1.9
17			2.8	2.0	2.1	2.15	2.0	2.1	1.8	1.8	1.95	
18			2.5	2.0	2.2	2.1	2.0	2.0	1.8	1.8	1.95	
19			2.6	2.0	2.15	2.1	2.0	2.0	1.8	1.8	1.95	
20		2.8	2.6	2.0	2.1	2.0	2.0	2.0	1.8	1.8	1.9	
21	2.3		2.6	2.0	2.05	2.0	2.35	1.9	1.8	1.8	1.9	
22		3.1	2.6	2.0	2.0	1.95	2.35	1.9	1.8	1.8	1.9	
23			2.65	2.0	2.0	1.95	2.35	1.9	1.8	1.8	1.95	
24		3.1	2.7	2.0	2.0	1.95	2.35	1.9	1.8	1.8	1.95	
25		3.2	2.75	2.0	2.0	1.95	2.3	1.9	1.8	1.8	1.95	
26		3.6	2.9	2.0	1.95	1.9	2.1	1.9	1.8	1.8	1.9	
27		3.8	2.85	2.0	1.95	1.9	2.0	1.9	1.8	1.8	1.9	
28	2.3	3.9	2.6	2.0	1.95	1.85	2.0	1.9	1.8	1.8	1.9	
29			2.65	1.95	1.95	1.8	2.0	1.9	1.8	1.8	1.9	
30			2.5	1.95	1.95	1.8	2.0	1.9	1.8	1.8	1.9	
31			2.4		1.95		2.0	1.9		1.8		

NOTE.—River frozen over January 1 to February 26; also March 7 to 19. Gage heights are to water surface in hole cut in ice. Thickness of ice, 1 to 1.8 feet.

Station rating table for Des Lacs River at Foxholm, N. Dak., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	1	2.50	8	3.20	22	3.90	44
1.90	2	2.60	10	3.30	25	4.00	48
2.00	3	2.70	12	3.40	28	4.10	52
2.10	4	2.80	14	3.50	31	4.20	56
2.20	5	2.90	16	3.60	34	4.30	60
2.30	6	3.00	18	3.70	37	4.40	64
2.40	7	3.10	20	3.80	40	4.50	68

The above table is applicable only for open channel conditions. It is based on 10 discharge measurements made during 1904–1905. It is fairly well defined between gage heights 2 feet and 4 feet.

Estimated monthly discharge of Des Lacs River at Foxholm, N. Dak., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March (18 days)	37	7	17.3	618
April	6.5	2.5	3.9	232
May	5	2.5	3.1	191
June	8	1	3.1	184
July	40	.5	4.8	295
August	250	2	16.5	1,014
September	1.5	1	1.0	60
October	1	1	1.0	61
November	3	1	2.0	119
December 1–16	2	2	2.0	64
The period				2,838

NOTE.—No estimate for ice period.

UPPER MISSISSIPPI RIVER DRAINAGE.

GENERAL FEATURES.

The sources of Mississippi River proper lie between latitudes 47° and 48° north, almost exactly in the center of the continent on an east-west line; its mouth is in latitude 29° north.

The basin, very irregular in outline, can best be described as an oblong, with the major axis, 1,700 miles in length, running southeastward from the northwestern part of Montana, through North Dakota, Nebraska, Missouri, and Tennessee into the northwestern corner of Alabama. On each side of this line the basin spreads out from 300 to 500 miles, while on the east there is a large protuberance from the general outline extending to the Alleghany Mountains.

The total area drained by the Mississippi and its tributaries is 1,240,000 square miles. It includes wholly or in part thirty States, besides a small area in the Dominion of Canada.

The eastern outline of the basin conforms roughly to that of the Atlantic coast, the mean distance between them being about 250 miles. The eastern and western outlines are determined by the two great mountain systems of the continent, the Appalachian and the Cordilleran.

Topographically the country included within the Mississippi basin presents all varieties of form. Mountain and prairie, arid plain, and alluvial bottom land teeming with vegetation are all represented.

The drainage system may be divided into four grand sections, in the following order of size: (1) The Missouri basin, (2) the basins of Arkansas and Red rivers, (3) the Ohio basin, and (4) the basin of the Upper Mississippi. The area last named, which is considered in this report, extends from the source of the river to the mouth of the Missouri; below that the stream is called the Lower Mississippi.

In the northern part of Minnesota, 2,555 miles from the Gulf of Mexico, is a low plain, consisting of sandy ridges of glacial origin, known as the Hauteur des Terres. It is a region of innumerable lakes, and from one of the smallest of these, Hernando de Soto, springs the great river. Lake Hernando de Soto is drained by a small stream flowing into Itasca Lake, which was for many years considered the source of the river. The length of Itasca Lake is about 4 miles, and its breadth nowhere exceeds one-half mile. Its outlet is from 10 to 12 feet wide and from 12 to 18 inches deep.

From its utmost source to the falls of Pokegama the river flows through a drift-covered region, in a valley which is in some places narrow, in others broad and savanna-like, with many rapids in the narrower and with gentle or sluggish currents in the broader portions. In this part of its course it drains a number of lakes, among which Bemidji, Cass, Winnibigoshish, and Leech lakes are the most important. The total fall from the head of the stream to the mouth of Leech Lake River, which is nearly as large as the main stream, is about 420 feet. The first rock in place is at Pokegama Falls, and thence to the mouth of Crow Wing River, which enters from the west, the average width of the stream is 300 feet, the valley is less winding, and the current is good, with many rapids of small extent. The mouth of Crow Wing River is only 75 miles in a straight line from Lake Itasca, but the distance along the river course is 450 miles.

Below the mouth of the Crow Wing the river flows in a general southerly direction for about 475 miles. Within this stretch are several rapids, the chief being Little Falls and Sauk Rapids, and many timbered islands. The banks are abrupt, of clay or sandy loam, and lead to meadows that stand 60 feet above the river. At the Falls of St. Anthony the river pitches down a vertical fall and rapid amounting to 75 feet in half a mile, and in so doing leaves the prairie and clay banks for a channel that lies between rocky bluffs of limestone and sandstone, which continue for many miles down the river, gradually increasing to a height of 500 feet as the bed sinks below the general prairie level. The sides of the bluffs are not vertical, bare surfaces of rock, but are composed of easily-eroded stone and drift, which form well-wooded or grassy slopes.

Minnesota River, formerly called St. Peters River, enters the Mississippi about 10 miles below St. Anthony Falls, and below its mouth the breadth of the main stream averages 1,000 feet. From this point to the mouth of the Missouri the general characteristics of the river are the same—a broad placid stream with innumerable islands, the entire width of the valley averaging 1 mile. In many places, especially where tributaries enter, there are fertile flats between the river and the bluffs. Fifty-five miles below the mouth of the Minnesota is Lake Pepin, an expansion of the river apparently caused by the immense quantities of sand brought down by the Chippewa.

At two places exceptions occur to the otherwise placid character of the river. At Rock Island, Ill., 384 miles from St. Paul, there are rapids by which the river falls 20.4 feet in 12 miles, and at Keokuk, Iowa, 509 miles from St. Paul, is the foot of the Des Moines Rapids, where in a distance of 11 miles the river falls 21.85 feet.

The large tributaries below the Minnesota are the St. Croix, Chippewa, Wisconsin, Rock, and Illinois from the east, and the Iowa and Des Moines from the west.

MISSISSIPPI RIVER.

MISSISSIPPI RIVER NEAR SAUK RAPIDS, MINN.

This station was established April 23, 1903. It is located about 1½ miles south of Watab station, on the Northern Pacific Railway, about 5 miles north of Sauk Rapids and 7 miles north of St. Cloud.

The channel is straight for 4,000 feet above the station and 600 feet below. Both banks are high and not subject to overflow. The bed consists of sand and gravel and is somewhat shifting. There is but one channel at all stages. The channel has a width of 625 feet at low water and about 700 feet at high stages. The current is of medium swiftness.

Discharge measurements are made from a boat running on a cable, which is securely fastened to trees on each side of the river. The point to which soundings are referred is a nail head in the root of a tree on the left bank, to which the cable is fastened.

The gage, which was read during 1905 by Frank McCrea, is a vertical timber fastened to a post driven into the bed on the left side of the river. It is referred to bench marks as follows: (1) Top of a large, pointed rock, 150 feet upstream from the gage and 10 feet from the water's edge; elevation above zero of gage, 18.58 feet. (2) A ⅝-inch iron stake, driven on the left shore between the cable and bench mark No. 1; elevation above zero of gage, 14.22 feet. (3) On root of a small elm tree, on left bank of river, just below cable; elevation, 18.29 feet above gage zero. A short distance above the old gage is a large rock with a vertical face at an elevation of 14.45 feet above the zero of the gage. Observations of the river height can be made by determining distances from the top of this rock to the water surface.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 98, pp 173-174; 128, p 18.
Discharge: Ann 22, iv, p 219; WS 98, p 174; 128, p 19.
Gage heights: WS 98, pp 174-175; 128, p 19.

Discharge measurements of Mississippi River near Sauk Rapids, Minn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	R. Richards	560	1,813	1.44	11.29	2,619
April 5	do	582	3,889	2.19	13.60	8,523

Daily gage height, in feet, of Mississippi River near Sauk Rapids, Minn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.2	11.25	.....	11.35	11.45	13.45	18.1	14.25	13.85	12.85	12.5	12.[illegible]
2	11.2	11.25	11.5	11.3	11.45	13.35	17.9	14.25	13.85	12.9	12.4	....
3	11.3	11.25	11.65	11.8	12.2	13.2	17.6	14.25	13.85	13.0	12.5	.....
4	11.2	11.25	11.7	12.4	13.2	13.1	18.2	14.25	13.85	12.95	12.6	.....
5	11.25	11.25	.....	13.6	14.0	13.9	18.8	14.35	13.85	12.9	12.4	.....
6	11.25	11.25	.....	14.0	14.4	14.5	19.8	14.5	13.85	12.8	12.5	13.15
7	11.25	11.25	11.65	14.3	14.45	14.7	20.1	14.6	13.8	12.75	12.55	.....
8	11.25	11.25	.....	14.1	14.5	14.7	20.2	14.8	13.75	12.75	12.55	.....
9	11.4	11.25	.....	13.8	14.6	14.8	20.1	14.8	13.7	12.6	12.5	.....
10	11.3	11.25	.....	13.5	14.9	14.9	19.6	15.2	13.65	12.55	12.45	.....
11	11.25	11.25	11.6	13.4	15.8	14.9	19.2	15.2	13.5	12.5	12.35	13.1
12	11.2	.....	.....	13.4	16.3	15.0	18.6	15.2	13.65	12.35	12.35	.....
13	11.25	.....	11.4	13.2	16.2	15.2	18.2	15.1	13.6	12.2	12.25	.....
14	11.25	.....	.....	13.0	16.5	15.4	19.8	15.05	13.6	12.0	12.3	.....
15	11.25	.....	.....	12.85	16.5	15.6	17.5	15.2	13.65	12.0	12.25	.....
16	11.25	.....	.....	12.85	16.5	16.1	17.2	15.3	13.65	12.0	12.25	.....
17	11.25	.....	.....	12.7	16.0	16.8	16.8	15.1	13.6	12.45	12.2	.....
18	11.25	11.2	.....	12.65	15.5	17.0	16.6	15.0	13.8	12.5	12.2	13.[illegible]
19	11.25	.....	11.2	12.65	15.4	17.2	16.4	14.9	14.2	12.6	12.1	.....
20	11.25	.....	.....	12.4	15.0	17.6	16.4	14.8	14.2	12.75	12.1	.....
21	11.25	.....	.....	12.35	15.0	17.6	16.2	14.7	14.2	12.95	12.05	.....
22	11.25	11.35	.....	12.2	15.0	17.4	16.1	15.0	14.2	12.95	12.05	.....
23	11.3	.....	11.65	12.05	15.25	17.2	16.0	14.7	14.2	13.0	12.15	.....
24	11.25	.....	11.65	11.8	15.3	17.3	15.8	14.35	14.0	13.1	12.5	.....
25	11.25	.....	11.4	11.6	15.2	17.3	15.6	14.45	13.7	13.15	13.0	.....
26	11.25	.....	11.4	11.45	15.0	18.2	15.4	14.5	13.5	13.1	12.9	12.9
27	11.25	11.4	11.55	11.3	14.6	18.2	15.1	14.4	13.35	13.05	13.0	.....
28	11.25	.....	11.6	11.2	14.3	18.3	14.9	14.2	13.2	13.0	12.45	.....
29	11.25	.....	11.6	11.25	14.2	18.3	14.7	14.2	13.0	12.95	12.05	.....
30	11.25	.....	11.5	11.4	13.7	18.2	14.45	14.0	12.9	12.8	12.0	.....
31	11.25	.....	11.4	.....	13.6	.....	14.2	13.95	.....	12.85	.....	.....

NOTE.—River frozen over January 1 to March 23; also December 1-31. Gage heights are to water surface in a hole in the ice.

MISSISSIPPI RIVER AT ANOKA, MINN.

This station was established May 8, 1905. It is located at a highway bridge three-fourths of a mile southwest of Anoka.

The channel is straight for about 1 mile above the station and for about one-half mile below, and is broken by four bridge piers. The right and left banks are clean and slope gently upward to a height of 25 feet above gage zero; they are not subject to overflow. The bed of the stream is composed of gravel and is probably nearly constant, except as affected by sunken logs, which cover the bed occasionally at some points. There is one channel at all stages. The current is medium.

Discharge measurements are made from the lower side of the steel highway bridge, to which the gage is attached. The initial point for soundings is the end of the bridge hand rail on the left bank, lower side.

The gage is composed of a 6-inch timber, 12 feet long, bolted to the lower side of the first stone pier of the bridge from the left bank. The gage was read during 1905 by Walter A. Griffith. This gage is attached to the same pier and at the same height as the United States engineers' gage placed there in 1896.

Discharge measurements of Mississippi River at Anoka, Minn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 8	E. F. Chandler	762	5,046	2.96	3.08	14,950
July 21	R. Richards	785	6,585	4.13	4.98	27,180
August 1	E. F. Chandler	772	4,674	3.33	2.97	15,570
August 15	do	774	5,089	3.22	3.26	16,400

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.65	6.6	3.0	2.6	2.25	2.0	4.45
2	.....	2.4	6.6	3.0	2.55	2.15	1.8	4.45
3	.....	2.2	6.6	3.0	2.5	2.15	1.75	4.45
4	.....	2.2	6.7	3.0	2.4	2.05	1.75	4.45
5	.....	3.0	6.9	2.95	2.4	2.05	1.75	4.35
6	.....	3.2	7.5	2.95	2.4	2.0	1.75	4.4
7	.....	3.5	8.2	3.0	2.4	1.9	1.75	4.6
8	.....	3.7	8.7	3.05	2.4	1.9	1.9	4.6
9	3.1	3.9	8.8	3.05	2.35	1.9	1.9	5.65
10	3.45	4.0	8.6	3.05	2.35	1.9	1.9	5.2
11	3.8	4.0	8.4	3.05	2.3	1.9	1.9	.....
12	4.45	4.0	8.0	3.2	2.2	1.55	1.9	.....
13	5.4	4.0	7.8	3.25	2.2	1.55	1.75	.....
14	5.7	4.0	7.5	3.25	2.2	1.55	1.75	.....
15	6.1	4.0	6.7	3.25	2.25	1.55	1.6	.....
16	6.2	4.3	6.3	3.4	2.35	1.55	1.55	.....
17	6.6	4.6	6.0	3.9	2.25	1.55	1.55	4.6
18	6.4	5.3	5.6	3.85	2.5	1.55	1.55	.....
19	6.05	5.8	5.45	[a] 3.7	2.8	1.55	1.4	.....
20	5.55	5.9	5.0	3.6	3.0	1.55	1.4	.....
21	5.2	5.95	5.0	3.8	3.15	2.2	1.4	.....
22	5.05	5.9	4.9	3.65	3.0	2.2	1.4	.....
23	4.9	5.8	[a] 4.8	3.4	2.95	2.2	1.3	.....
24	4.8	5.7	4.7	3.4	3.1	2.4	1.6	.....
25	4.5	5.8	4.45	3.4	3.1	2.4	1.8	.....
26	4.35	6.05	4.0	3.15	3.1	2.4	2.0	.....
27	3.95	6.4	3.85	3.3	2.6	2.6	2.0	.....
28	3.65	6.6	3.65	3.25	2.6	2.6	2.0	2.25
29	3.5	[a] 6.6	3.55	3.0	2.4	2.4	2.45	.....
30	3.2	6.6	3.5	2.9	2.35	2.4	4.45	.....
31	2.95	.....	3.3	2.7	.....	2.3	.....	.....

[a] Gage heights interpolated.

NOTE.—River frozen part way across December 10–31.

RUM RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Rum River, so named on account of the color of its water, starts from the southwestern part of Mille Lacs, in east-central Minnesota, flows southward, and enters the east side of the Mississippi at Anoka, 7½ miles below the mouth of Crow River. Its basin is about 80 miles long and averages not over 19 miles in width. The large body of water at its head serves an important part in maintaining the flow during low water. The stream flows between banks of clay or mud, and where it crosses the ridge of granite which produces Sauk Rapids on the Mississippi there is a slight fall over rock in place.

Rum River has been largely used for lumbering, and on the small tributaries are many dams, built for the purpose of holding and flushing logs into the main river.

RUM RIVER NEAR ANOKA, MINN.

This station was established May 8, 1905. It is located at the highway bridge 6½ miles due north of Anoka, the distance by road being 7½ miles.

The channel is straight for 400 feet above and 300 feet below the station, broken by one pier at ordinary stages and by two piers at high stages. The right bank is composed of brush, and will overflow at ordinary floods. The left bank is a road, graded to the bridge abutment, and will not overflow. Grassy flats above and below the bridge will be covered by high floods. The bed of the stream is composed of sand and silt and is probably nearly constant. The current is sluggish at medium stages.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the center of the circular iron pier on the lower side of the bridge on the left bank. On account of the obliquity of the bridge, distances of 10.5 feet are marked along the bridge and considered as 10 feet.

The standard chain gage is located at the middle of the bridge span. The length of the chain from the end of the weight to the marker is 20.65 feet. The gage was read during 1905 by Henry E. Faherty.

Discharge measurements of Rum River near Anoka, Minn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 8	E. F. Chandler	150	1,130	1.80	14.46	2,035
July 22	R. Richards	149	905	1.15	12.80	1,036
August 2	E. F. Chandler	148	768	.93	11.91	715
August 15	do	148	783	.86	11.78	670

Daily gage height, in feet, of Rum River near Anoka, Minn., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	12.1	14.2	11.9	11.95	12.45	13.4	14.25
2	.....	11.9	14.1	11.95	11.9	12.6	13.15	14.1
3	.....	11.9	14.15	12.0	12.4	12.5	12.95	.....
4	.....	12.0	14.25	11.9	12.6	12.3	12.8	.....
5	.....	12.2	14.4	12.0	12.4	12.25	12.95	.....
6	.....	12.1	14.75	11.9	12.6	12.2	13.15	.....
7	.....	14.0	15.2	11.95	12.5	12.1	13.2	.....
8	14.5	14.8	15.5	11.95	12.5	12.05	13.35	.....
9	14.7	15.2	15.9	11.95	12.4	12.0	13.35	.....
10	15.2	15.7	16.4	11.9	12.2	12.3	13.45	.....
11	15.45	16.0	17.0	11.9	12.1	12.7	13.4	14.2
12	15.4	16.1	17.4	11.8	12.15	12.5	13.3	.....
13	15.4	16.0	17.4	11.75	12.2	12.45	13.4	.....
14	15.45	15.8	17.0	11.75	12.3	12.4	13.1	.....
15	15.7	15.4	15.9	11.8	12.2	12.5	13.0	.....
16	16.6	15.4	15.3	11.8	12.6	12.85	12.95	.....
17	17.2	15.3	14.35	12.2	12.5	12.95	12.9	.....
18	17.3	15.3	13.8	13.1	13.1	13.25	12.85	13.65
19	17.1	15.35	13.4	13.2	13.5	13.6	12.8	.....
20	16.8	15.35	13.1	13.25	13.8	13.85	12.7	.....
21	16.5	15.4	12.9	13.4	14.1	14.0	12.7	.....
22	16.3	15.45	12.8	13.55	14.15	14.15	12.65	.....
23	15.8	15.5	12.6	13.3	14.3	14.0	12.7	.....
24	15.4	15.45	12.2	13.15	13.95	13.95	12.9	.....
25	14.9	15.45	11.95	13.0	13.7	14.1	13.0	.....
26	14.7	15.3	12.1	12.8	13.45	14.15	13.1	.....
27	14.15	15.1	12.2	12.6	13.1	14.05	13.4	.....
28	13.7	14.4	12.15	12.3	12.8	13.8	13.6	13.25
29	13.2	14.2	12.15	12.2	12.6	13.65	13.9	.....
30	12.7	14.2	11.4	12.05	12.5	13.5	14.4	.....
31	12.3	.....	11.8	12.0	.....	13.45	.....	.....

NOTE.—River frozen over during December. Gage heights are to water surface in a hole in the ice. Thickness of ice, 0.7 to 1 foot.

Station rating table for Rum River near Anoka, Minn., from May 8 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
11.00	474	12.30	838	13.60	1,450	15.80	3,180
11.10	492	12.40	874	13.70	1,510	16.00	3,370
11.20	512	12.50	910	13.80	1,570	16.20	3,560
11.30	534	12.60	950	13.90	1,635	16.40	3,760
11.40	558	12.70	990	14.00	1,700	16.60	3,960
11.50	584	12.80	1,035	14.20	1,840	16.80	4,160
11.60	612	12.90	1,080	14.40	1,985	17.00	4,370
11.70	642	13.00	1,130	14.60	2,135	17.20	4,580
11.80	672	13.10	1,180	14.80	2,295	17.40	4,790
11.90	704	13.20	1,230	15.00	2,460	17.60	5,010
12.00	736	13.30	1,280	15.20	2,630	17.80	5,230
12.10	770	13.40	1,335	15.40	2,810	18.00	5,450
12.20	804	13.50	1,390	15.60	2,990		

The above table is applicable only for open-channel conditions. It is based on four very consistent discharge measurements made during 1905. It is well defined between gage heights 11.7 feet and 14.5 feet. Above 14.5 feet table is based on product of area and velocity curves extended.

Estimated monthly discharge of Rum River near Anoka, Minn., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 8-31	4,685	838	2,817	134,100
June	3,465	704	2,313	137,600
July	4,790	558	2,045	125,700
August	1,420	657	876	53,860
September	1,910	704	1,089	64,800
October	1,805	736	1,205	74,090
November	1,985	970	1,216	72,300
The period				662,500

NOTE.—No estimate for ice period.

MINNESOTA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Minnesota River rises in Bigstone Lake, which forms part of the boundary between South Dakota and Minnesota, flows southeastward to the city of Mankato, in the northern part of Blue Earth County, where it makes an abrupt turn to the north, and continues in a northerly and northeasterly direction until it enters the Mississippi at a point midway between Minneapolis and St. Paul. The course of this river is generally marked by wide bottom lands. It has a sluggish current, affording few opportunities for the development of water power.

MINNESOTA RIVER NEAR MANKATO, MINN.

This station was established May 20, 1903. It is located at Sibley Park, 1 mile below the highway and railroad bridges across Blue Earth River and 1½ miles above the city bridge in Mankato. Blue Earth River joins the Minnesota about 500 feet above the station.

The channel is straight for 1,000 feet above and 2,000 feet below the station, with a width of about 300 feet at low water and 350 feet at high stages. There is but one channel at all stages. The left bank is low and liable to overflow for a distance of 50 to 75 feet from the gage. The right bank is a steep, rocky bluff. The bed of the stream is composed of sand, gravel, and blue earth, and may shift somewhat at high water. The current velocity is moderate, though somewhat sluggish near the banks at low stages.

Discharge measurements are made from a small rowboat running on a cable. The initial point for soundings is a spike in the base of the willow tree to which the small cable is attached on the right bank.

The gage, which was read during 1905 by George E. Blake, is a vertical timber fastened to a post, which is driven into the river bed a few feet from the right bank. The bench mark is on a 20-inch cottonwood tree on the right bank a short distance above the station and about 30 feet from the water's edge; its elevation is 14.78 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp. 15-16; 130, pp 53-54.
Discharge: 99, p 16; 130, p 54.
Gage heights: 99, p 17; 130, pp 54-55.

Discharge measurements of Minnesota River near Mankato, Minn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 3	R. Richards	295	1,400	2.34	4.98	3,282
May 10	E. F. Chandler	294	1,042	2.35	4.16	2,454
June 18	R. Richards	310	2,517	3.25	8.60	8,179
September 12	do	285	877	1.54	2.78	1,347

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	1.9	3.95	5.1	2.85	5.95	6.2	5.25	3.2	2.8	2.75	4.0
2	1.8	1.9	4.15	5.15	2.85	5.8	7.5	5.1	3.15	2.75	2.65	8.05
3	1.8	1.9	4.4	5.0	2.9	5.65	7.8	5.0	3.1	2.7	2.7	7.8
4	1.85	1.9	5.4	4.95	3.25	5.5	8.8	4.8	3.05	2.65	2.65	7.4
5	1.85	1.9	5.6	5.1	3.8	5.35	9.4	4.65	3.0	2.65	2.75	7.3
6	1.8	1.9	6.0	5.15	3.9	5.2	10.6	4.5	2.95	2.55	3.1	7.5
7	1.8	1.9	5.8	5.15	3.85	5.05	11.7	4.45	2.85	2.55	3.2	7.3
8	1.8	1.9	5.4	5.1	3.7	4.8	12.2	4.3	2.85	2.55	3.4	7.0
9	1.8	1.9	5.2	5.0	3.65	4.7	12.5	4.2	2.8	2.5	3.5	6.7
10	1.8	1.9	4.7	4.8	4.1	4.6	12.0	4.1	2.75	2.65	3.5	6.1
11	1.8	1.9	4.1	4.6	5.05	4.5	11.8	4.0	2.75	2.55	3.5	6.0
12	1.9	2.0	4.0	4.4	6.0	4.45	11.2	3.85	2.75	2.5	3.5	5.9
13	1.9	2.05	4.3	4.25	6.3	4.3	11.7	3.7	2.7	2.45	3.45	5.8
14	1.9	2.05	3.5	4.1	7.0	4.25	10.2	3.7	2.65	2.5	3.45	5.5
15	1.9	2.1	3.7	4.0	8.0	4.1	9.8	3.7	2.75	2.7	3.4	5.35
16	1.9	2.1	3.85	3.8	9.2	4.15	9.3	3.7	2.7	2.75	3.35	5.1
17	1.9	2.1	3.9	3.8	9.8	4.3	9.0	3.5	2.75	2.75	3.25	4.95
18	1.9	2.1	4.0	3.7	10.0	4.2	8.7	3.7	2.75	2.8	3.25	4.85
19	1.9	2.1	.....	3.6	9.9	4.3	8.4	3.7	4.45	2.7	3.2	4.6
20	1.9	2.1	.....	3.5	9.8	4.25	8.1	3.6	3.75	2.8	3.2	4.5
21	1.9	2.0	.....	3.4	9.6	4.2	7.8	3.55	3.5	2.8	3.15	4.45
22	1.9	2.0	.....	3.25	9.2	4.05	7.6	3.5	3.45	2.85	3.1	4.4
23	1.9	2.3	.....	3.2	8.8	4.0	7.3	3.4	3.35	2.9	3.05	4.1
24	1.9	2.4	.....	3.2	8.2	3.95	7.0	3.85	3.25	2.9	3.4	3.85
25	1.9	3.0	.....	3.1	7.8	4.75	6.8	3.7	3.05	2.85	3.6	3.9
26	1.9	3.5	.....	3.1	7.4	5.6	6.6	3.55	2.95	2.85	3.75	3.9
27	1.9	3.7	.....	3.0	7.4	6.1	6.3	3.5	2.95	2.8	3.8	3.85
28	1.9	4.4	.....	2.95	6.6	6.2	6.0	3.5	2.9	2.8	5.05	3.8
29	1.9	.....	.....	2.9	6.4	5.9	5.9	3.45	2.85	2.8	5.6	3.7
30	1.9	.....	.....	2.85	6.2	5.8	5.6	3.4	2.8	2.8	4.4	3.6
31	1.9	.....	.....	.....	6.05	.....	5.4	3.25	.....	2.75	.....	3.6

NOTE.—Ice conditions January 1 to February 28, also December 1-31. Gage heights are to water surface.

Station rating table for Minnesota River near Mankato, Minn., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	840	3.50	1,805	5.00	3,310	7.80	7,010
2.10	885	3.60	1,890	5.20	3,550	8.00	7,300
2.20	935	3.70	1,980	5.40	3,790	8.20	7.600
2.30	985	3.80	2,070	5.60	4,030	8.40	7,900
2.40	1,040	3.90	2,165	5.80	4,270	8.60	8,200
2.50	1,095	4.00	2,260	6.00	4,530	8.80	8,500
2.60	1,155	4.10	2,360	6.20	4,790	9.00	8,800
2.70	1,215	4.20	2,460	6.40	5,050	9.20	9,100
2.80	1,280	4.30	2,560	6.60	5,330	9.40	9,400
2.90	1,345	4.40	2,660	6.80	5,610	9.60	9,710
3.00	1,415	4.50	2,760	7.00	5,890	9.80	10,030
3.10	1,485	4.60	2,870	7.20	6,170	10.00	10,350
3.20	1,560	4.70	2,980	7.40	6,450	10.20	10,670
3.30	1,640	4.80	3,090	7.60	6,730	10.40	10,990
3.40	1,720	4.90	3,200				

The above table is applicable only for open channel conditions. It is based on four discharge measurements made during 1905. It is well defined between gage heights 2.8 feet and 8.6 feet. The table has been extended beyond these limits. On account of changes at gaging section, measurements of previous years were not considered applicable. This table gives 25 per cent increase over 1903 table for low stages and 5 to 15 per cent decrease for high stages.

Estimated monthly discharge of Minnesota River near Mankato, Minn., for 1905.

[Drainage area, 13,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 1-18	4,530	1,805	2,874	102,600	0.214	0.143
April	3,490	1,312	2,369	141,000	.177	.198
May	10,350	1,312	5,435	334,200	.406	.468
June	4,790	2,212	3,205	190,700	.239	.267
July	14,350	3,790	8,452	519,700	.631	.728
August	3,610	1,600	2,232	137,200	.167	.192
September	2,710	1,185	1,452	86,400	.108	.120
October	1,345	1,068	1,223	75,200	.091	.105
November	4,030	1,185	1,784	106,200	.133	.148
The period	.....	.....	.....	1,693,[illegible]00	.....	.....

NOTE.—No record March 19-31. No estimate for ice period.

CHIPPEWA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Chippewa River rises in the southeastern part of Ashland County, Wis., flows southwestward, and unites with the Mississippi near Wabash, Minn. Its principal tributary is Flambeau River, which enters from the east, in Gates County.

CHIPPEWA RIVER NEAR EAU CLAIRE, WIS.

This station was established November 13, 1902. It is located 2 miles below Eau Claire, at a suburb known as Shawtown.

The channel is straight above and below the station. The right bank is protected by a high masonry wall; the left bank is low, but the water is confined by an earthern embankment. The bed of the stream is composed of gravel, with a few rocks, and is permanent. There is one channel, broken by one pier, at all stages, the width being 450 feet at low water and 500 feet at flood stages. The current is fairly swift.

Discharge measurements are made from a two-span highway bridge. The initial point for soundings is a point marked by two nails in the footway at the right end of the bridge.

A standard chain gage, which was read during 1905 by Joseph E. Kimpton, is fastened to the downstream side of the highway bridge. The length of the chain from the end of the weight to the marker is 30.69 feet. The bench mark is a nail in the top of a 6-inch white-oak stump which is attached to a tree, still standing, located about 200 feet east of the road and 200 feet south of the river; elevation above zero of gage, 20.09 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, p 166; 98, p 177; 128, p 20.
Discharge: 83, p 166; 98, p 178; 128, p 21.
Discharge, monthly: 98, p 180; 128, p 22.
Gage heights: 83, p 167; 98, pp 178-179; 128, p 21.
Rating tables: 98, pp 179-180; 128, p 22.

Discharge measurements of Chippewa River near Eau Claire, Wis., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 24	S. K. Clapp	200	4,400	3.66	8.80	16,110
June 14	M. S. Brennan	427	5,131	3.83	10.72	19,660
July 12	do	355	3,585	2.09	6.55	7,489
August 12	do	335	3,062	1.29	5.00	3,948

Daily gage height, in feet, of Chippewa River near Eau Claire, Wis., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				12.0	6.8	6.3	6.8	6.8	6.5	5.15	5.7	4.75
2	4.36			10.2	5.8	6.8	7.4	5.75	6.2	5.55	6.15	5.15
3				11.2	5.9	6.5	6.3	4.35	5.3	7.8	5.45	4.8
4				10.5	6.5	8.2	6.2	4.35	6.1	5.55	5.75	5.65
5		4.8	4.2	10.4	7.5	12.1	6.9	4.75	6.8	4.9	5.65	4.45
6				10.8	6.6	19.2	10.4	5.1	6.5	4.9	5.75	5.4
7				10.2	7.3		10.6	5.25	6.1	7.5	6.1	5.4
8				9.8	7.6	19.6	11.3	5.05	5.65	5.0	6.3	5.9
9	4.4		4.5	9.2	7.3	17.3	10.1	5.3	5.75	4.85	6.05	5.85
10				8.9	8.8	14.5	7.0	5.9	5.1	4.8	6.1	5.35
11				8.7	7.8	13.0	8.1	4.9	4.9	5.5	6.5	5.3
12			4.3	7.4	7.9	12.6	6.9	5.45	5.35	7.9	5.5	5.3
13		5.3	4.3	5.75	7.5	11.5	6.9	5.1	6.9	6.2	5.7	5.3
14			4.25	5.65	9.5	10.0	7.2	5.35	5.85	5.9	5.8	5.25
15	4.8		4.1	6.1	10.7	9.4	7.1	5.7	5.4	5.25	5.2	5.0
16			4.5	5.75	12.2	8.8	7.6	4.45	5.55	6.4	6.2	4.6
17			4.5	6.2	12.9	8.7	6.8	4.45	7.7	7.35	5.5	4.7
1		5.36	4.65	7.0	12.0	10.2	6.5	5.6	10.7	7.8	6.0	4.8
19			4.4	5.6	10.6	12.2	6.6	5.25	7.0	7.9	5.5	4.7
20			4.45	5.45	10.2	11.3	6.7	7.4	10.1	8.95	5.45	4.7
21			4.55	5.4	9.2	10.5	6.0	7.3	10.8	8.5	5.4	4.65
22	4.67		5.5	5.4	8.6	9.1	6.4	8.9	10.3	8.65	4.6	4.85
23			6.2	5.05	8.6	9.0	5.7	5.85	9.2	8.35	5.2	4.55
24			7.1	5.3	8.0	8.8	6.1	6.2	8.4	7.9	5.0	4.6
25		4.95	7.8	5.3	8.1	8.2	5.75	6.4	6.5	7.55	5.2	4.1
26			8.9	6.3	7.5	7.3	5.55	8.3	8.5	7.2	5.7	4.8
27			10.4	5.5	7.7	7.5	4.9	5.3	6.0	7.1	6.05	4.6
28			11.8	4.8	7.0	8.7	4.45	5.0	6.0	7.0	5.7	4.65
29	5.17		13.2	5.05	7.1	7.8	5.3	7.8	7.9	6.6	5.7	4.55
30			13.6	4.85	7.2	5.75	4.45	6.2	6.2	6.5	5.0	4.7
31			12.9		6.9		4.35	6.2		6.4		4.7

NOTE.—River frozen entirely across at gage January 1 to February 28; March 1 to 17, ice gradually disappeared. Thickness of ice, 2 to 2.5 feet. Gage heights are to water surface in a hole in the ice.

Station rating table for Chippewa River near Eau Claire, Wis., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.50	750	5.40	4,830	7.60	10,290	11.40	22,410
3.60	960	5.50	5,050	7.80	10,870	11.60	23,160
3.70	1,170	5.60	5,280	8.00	11,450	11.80	23,950
3.80	1,380	5.70	5,510	8.20	12,030	12.00	24,750
3.90	1,590	5.80	5,740	8.40	12,610	12.20	25,550
4.00	1,800	5.90	5,970	8.60	13,200	12.40	26,350
4.10	2,010	6.00	6,200	8.80	13,800	12.60	27,150
4.20	2,220	6.10	6,430	9.00	14,400	12.80	27,950
4.30	2,430	6.20	6,660	9.20	15,000	13.00	28,750
4.40	2,640	6.30	6,900	9.40	15,620	13.20	29,560
4.50	2,850	6.40	7,140	9.60	16,260	13.40	30,390
4.60	3,070	6.50	7,380	9.80	16,920	13.60	31,240
4.70	3,290	6.60	7,630	10.00	17,600	13.80	32,110
4.80	3,510	6.70	7,880	10.20	18,280	14.00	33,000
4.90	3,730	6.80	8,130	10.40	18,960	14.20	33,900
5.00	3,950	6.90	8,390	10.60	19,640	14.40	34,800
5.10	4,170	7.00	8,650	10.80	20,320	14.60	35,700
5.20	4,390	7.20	9,180	11.00	21,000	14.80	36,600
5.30	4,610	7.40	9,720	11.20	21,690	15.00	37,500

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904–5. It is well defined between gage heights 5 feet and 13 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Chippewa River near Eau Claire, Wis., for 1905.

[Drainage area, 6,740 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 18–31	31,240	2,640	13,510	2.00	1.04
April	24,750	3,510	10,180	1.51	1.68
May	28,350	5,740	12,670	1.88	2.17
June	60,520	5,625	20,370	3.02	3.26
July	22,050	2,535	8,626	1.28	1.48
August	14,100	2,535	5,867	.870	1.00
September	20,320	3,730	8,970	1.33	1.48
October	14,250	3,510	8,041	1.19	1.37
November	7,380	3,070	5,437	.807	.900
December	5,970	2,010	3,821	.567	.654

NOTE.—No estimate for ice period.

FLAMBEAU RIVER NEAR LADYSMITH, WIS.

Flambeau River rises in the lake of the same name in western Vilas County, Wis., flows southwestward, and unites with the Chippewa in the southern part of Gates County.

The gaging station was established February 13, 1903. It is located three-fourths of a mile south of the Minneapolis, St. Paul and Sault Ste. Marie Railway station, three-fourths of a mile south of Ladysmith, and one-half mile below the dam of the Menasha Pulp Company.

The channel is straight for 500 feet above and below the station. The right bank is low, but the overflow passes beneath the bridge. The left bank is high and is covered with trees. The gaging section is broad and shallow, with a bed of small bowlders, gravel, and sand, and is not liable to shift. The stream is divided into three channels by bridge piers. The channel is somewhat obstructed by log jams during the rafting season.

Discharge measurements are made from a three-span highway bridge. The initial point for soundings is at the right end of the bridge.

A standard chain gage, which was read during 1905 by Leonard McCandless and C. A. Phillips, is fastened to the upstream side of the right span. The length of the chain from the end of the weight to the marker is 25.40 feet. The bench mark is a cut on a rivet head on the post to which the pulley of the chain gage is attached; elevation, 36.28 feet above the gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 98, pp 180-181; 128, pp 22-23.
Discharge: 98, p 181; 128, p 23.
Discharge, monthly: 98, p 183; 128, p 25.
Gage heights: 98, pp 181-182; 128, p 24.
Rating tables: 98, p 182; 128, p 24.

Discharge measurements of Flambeau River near Ladysmith, Wis., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square-feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 8	S. K. Clapp	129	1,537	3.49	18.27	5,367
May 23	do	357	1,292	2.69	17.60	3,474
June 14	M. S. Brennan	354	1,232	2.67	17.35	3,288
July 12	do	353	1,015	2.54	16.80	2,576
August 12	do	345	623	1.84	15.66	1,144
September 23	F. W. Hanna	353	1,404	3.02	17.75	4,236

Daily gage height, in feet, of Flambeau River near Ladysmith, Wis., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				18.8	16.8	17.4	17.7	15.8	16.9	16.55	16.4	16.15
2				18.4	16.8	16.25	17.6	15.9	16.6	16.55	16.25	15.9
3				19.0	16.8	16.4	17.5	15.8	16.9	16.35	16.15	15.85
4		16.4	16.8	19.2	17.0	16.8	17.6	15.7	17.0	16.25	16.05	16.2
5				18.9	17.3	17.8	18.6	15.75	17.0	16.2	16.2	15.95
6				18.4	17.6	18.7	19.0	15.35	16.9	16.15	16.15	16.1
7	16.3			18.4	17.6	19.6	19.2	15.35	16.6	15.8	16.2	16.45
8				18.2	17.4	19.3	18.8	15.3	16.7	15.95	16.15	16.15
9				18.1	17.1	18.9	18.5	15.5	16.5	15.8	16.05	16.25
10				17.8	17.4	18.7	18.2	15.3	16.4	15.95	15.95	16.25
11		16.5	16.0	17.4	17.5	18.6	17.4	15.4	16.2	15.55	16.05	15.9
12				17.2	17.8	18.6	17.0	15.55	16.2	16.2	16.3	15.8
13				17.2	17.8	17.6	17.0	15.4	16.25	16.15	16.3	15.9
14	16.6			18.2	18.0	17.5	17.0	15.32	16.25	16.1	16.2	15.7
15				18.1	18.3	17.6	16.7	15.45	16.45	16.4	16.1	15.7
16				17.6	18.2	17.7	16.6	15.6	16.8	16.75	16.25	16.2
17				17.2	18.4	18.0	16.35	15.55	17.1	16.75	16.05	16.4
18		16.7	16.9	16.55	18.6	19.7	16.35	15.9	17.05	17.0	15.9	15.7
19				16.55	18.6	19.6	16.4	16.8	17.7	17.65	15.9	15.95
20				16.45	18.4	19.4	16.15	16.9	17.8	17.2	15.85	15.45
21	16.7			16.55	18.0	19.1	16.1	17.1	18.2	17.65	15.9	15.65
22				17.0	18.0	18.9	16.2	16.9	18.4	17.35	15.7	15.65
23				16.3	17.4	18.6	15.9	16.6	17.8	17.45	15.75	15.6
24			16.8	16.35	18.0	18.4	15.5	16.45	17.6	17.3	15.6	15.7
25		16.6	16.45	16.15	17.6	18.0	15.9	16.8	17.3	17.1	16.0	15.75
26			16.35	16.05	17.4	18.0	15.75	16.35	17.2	16.95	16.6	16.1
27			16.25	17.4	17.2	18.0	15.8	16.25	16.8	16.85	16.1	15.6
28	16.6		17.1	17.4	18.0	17.7	15.8	16.8	16.8	16.8	16.6	16.0
29			17.9	17.0	17.8	17.7	15.75	17.0	16.7	16.7	16.15	15.9
30			18.2	16.8	17.6	17.7	15.7	17.2	16.2	16.55	15.9	16.15
31			18.6		17.4		15.55	17.0		16.3		16.1

NOTE.—River frozen nearly across January 1-31, and entirely across February 1 to March 23. March 11-23 there was water on the ice. Gage heights are to water surface in a hole in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness.
	Feet.	*Feet.*	*Feet.*
January 7	16.3	16.4	0.7
January 14	16.6	16.8	1.3
January 21	16.7	16.9	1.4
January 28	16.6	16.9	1.5
February 4	16.4	16.9	1.7
February 11	16.5	16.9	1.7
February 18	16.7	17.1	2.0
February 25	16.6	16.9	1.8
March 4	16.8	17.8	1.8

Station rating table for Flambeau River near Ladysmith, Wis., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
15.00	600	16.20	1,735	17.40	3,510	18.50	5,770
15.10	670	16.30	1,855	17.50	3,700	18.60	5,980
15.20	745	16.40	1,980	17.60	3,890	18.70	6,190
15.30	825	16.50	2,110	17.70	4,090	18.80	6,400
15.40	910	16.60	2,245	17.80	4,300	18.90	6,610
15.50	1,000	16.70	2,385	17.90	4,510	19.00	6,820
15.60	1,090	16.80	2,530	18.00	4,720	19.20	7,240
15.70	1,185	16.90	2,680	18.10	4,930	19.40	7,680
15.80	1,285	17.00	2,835	18.20	5,140	19.60	8,120
15.90	1,390	17.10	2,995	18.30	5,350	19.80	8,560
16.00	1,500	17.20	3,160	18.40	5,560	20.00	9,000
16.10	1,615	17.30	3,330				

The above table is applicable only for open channel conditions. It is based on discharge measurements made during 1903-1905. It is not very well defined.

Estimated monthly discharge of Flambeau River near Ladysmith, Wis., for 1905.

[Drainage area, 2,120 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 24-31	5,980	1,795	3,384	1.60	0.476
April	7,240	1,558	3,867	1.82	2.03
May	5,980	2,530	4,090	1.93	2.22
June	8,340	1,795	5,223	2.46	2.74
July	7,240	1,000	2,950	1.39	1.60
August	3,160	825	1,669	.787	.907
September	5,560	1,735	2,839	1.34	1.50
October	3,990	1,045	2,305	1.09	1.26
November	2,245	1,090	1,616	.762	.850
December	2,045	955	1,449	.683	.787

NOTE.—No estimate for ice period.

BLACK RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Black River rises in the southeastern part of Taylor County, Wis., at an elevation between 1,300 and 1,400 feet above tide, flows in a general southwesterly direction for a distance of 128 miles, and joins the Mississippi about 10 miles above the town of La Crosse. Its basin, wedged in between that of the Wisconsin on the east and the Chippewa on the west, is long and narrow, being at one point scarcely more than 3 miles wide. The total area drained, measured at the mouth of the river, is 2,272 square miles.

The surface of the basin is gently rolling or level, and the country about the lower part of the river is well settled and under cultivation. The southern portion of the pine region crosses the basin between 60 and 80 miles from the mouth of the river, and all of the upper half of the area is forested. There are a few lakes at the upper waters, but the basin is not well supplied with natural reservoirs.

The river has a total fall of about 750 feet between source and mouth, or over 4.5 feet per mile. At Black River Falls there are very heavy rapids for a short distance, over hard, granite rock. The tributaries, which are characterized by many rapids and moderate falls, are all small streams of little importance, though they furnish power for a few small mills.

BLACK RIVER AT NEILLSVILLE, WIS.

This station was established April 7, 1905. It is located at the lower highway bridge at Neillsville, Wis., about 40 rods below the Chicago, St. Paul, Minneapolis and Omaha Railway bridge.

The channel is straight for 500 feet above and below the station. The right bank is high, alluvial, and clean; the left is high, rocky, and covered with scattered trees. Neither bank is liable to overflow. The bed of the stream is composed of gravel and rock, is free from vegetation, and is permanent. There is only one channel at high water, but there may be two at low stages. The current is swift at all times.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. The initial point for soundings is the inner face of the left abutment.

A standard chain gage, which was read once each day during 1905 by A. Bissell, is fastened to the bridge on the downstream side. The length of the chain from the end of the weight to the end of the chain proper is 29.01 feet. The gage is referred to bench marks as follows: (1) The highest point on a bowlder about 30 feet from the river and the same distance from the highway on the left bank; elevation above gage datum, 23.00 feet. (2) Top of the bottom of the downstream chord at the gage pulley; elevation above gage datum, 24.73 feet. (3) Top of bridge seat at the downstream right abutment; elevation above datum of gage, 23.55 feet.

Discharge measurements of Black River at Neillsville, Wis., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 7	Hanna and Clapp	192	1,021	3.25	7.70	3,279
May 24	S. K. Clapp	165	471	2.18	4.95	1,024
June 13	M. S. Brennan	192	945	3.15	7.26	2,978
July 11	do	161	392	1.56	4.25	612
August 11	do	151	242	.93	3.30	225
September 25	F. W. Hanna	163	419	1.86	4.35	780

Daily gage height, in feet, of Black River at Neillsville, Wis., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.4	3.7	4.4	2.7	3.3	3.5	3.7	4.0
2	.....	3.4	3.3	4.4	2.6	3.2	3.5	3.5	4.2
3	.....	4.1	3.2	4.9	2.6	3.5	3.4	3.5	3.8
4	.....	5.3	7.7	6.5	2.6	3.4	3.4	3.5	3.7
5	.....	5.2	14.2	8.4	2.9	3.6	3.0	3.5	3.8
6	8.2	4.9	19.8	8.0	2.7	3.2	3.0	3.7	3.5
7	7.7	5.0	16.5	6.8	4.2	3.1	3.1	4.1	3.5
8	6.9	4.6	11.5	5.9	4.0	3.0	2.7	4.1	3.4
9	6.2	4.6	8.8	5.3	4.0	2.9	2.4	3.9	3.3
10	6.0	5.9	7.6	4.7	3.5	2.8	3.1	3.8	3.4
11	5.7	6.6	8.6	4.2	3.3	2.7	3.0	3.7	3.4
12	5.5	6.7	8.0	3.8	3.3	2.8	3.0	3.7	3.5
13	5.1	6.2	7.1	3.9	3.3	2.7	3.0	3.6	3.4
14	4.8	10.7	6.2	4.0	3.3	2.7	3.0	3.5	3.4
15	4.6	10.1	5.5	4.8	3.2	4.3	4.0	3.4	3.5
16	4.3	9.2	5.8	4.5	3.0	6.0	4.9	3.4	3.4
17	3.9	8.7	11.2	4.0	2.9	6.0	5.4	3.4	3.3
18	3.8	8.2	10.7	3.8	3.0	6.1	5.5	3.4	3.0
19	4.2	6.6	8.6	4.2	3.0	8.6	5.6	3.4	3.0
20	3.9	6.0	7.0	4.3	3.0	8.3	6.6	3.3	3.2
21	3.2	5.3	6.0	4.0	3.2	7.5	6.9	3.2	3.1
22	3.1	5.1	5.2	3.8	3.5	6.3	6.5	3.2	3.1
23	3.1	4.9	4.5	3.3	3.4	5.8	5.9	3.2	3.3
24	3.5	4.7	4.1	3.1	3.6	4.7	5.5	3.5	3.5
25	3.4	4.3	3.9	3.1	3.4	4.2	5.0	4.2	3.5
26	3.4	4.2	3.7	3.0	3.3	3.9	4.6	4.6	3.5
27	3.4	4.1	3.5	2.9	3.2	3.8	4.4	4.5	3.4
28	3.4	3.9	3.3	2.9	3.0	3.7	4.1	4.3	3.4
29	3.4	3.9	3.3	2.8	3.4	3.6	3.9	3.9	3.4
30	3.4	3.8	3.5	2.8	3.5	3.8	3.7	3.7	3.5
31	.....	3.8	.....	2.7	3.3	.....	3.6	.....	3.5

NOTE.—No ice record at this station.

Station rating table for Black River at Neillsville, Wis., from April 6 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	150	4.80	990	6.60	2,310	8.40	4,120
3.10	177	4.90	1,055	6.70	2,395	8.50	4,230
3.20	205	5.00	1,120	6.80	2,480	8.60	4,340
3.30	235	5.10	1,185	6.90	2,570	8.70	4,460
3.40	267	5.20	1,250	7.00	2,660	8.80	4,580
3.50	301	5.30	1,315	7.10	2,750	8.90	4,700
3.60	338	5.40	1,385	7.20	2,850	9.00	4,820
3.70	379	5.50	1,455	7.30	2,950	9.10	4,940
3.80	424	5.60	1,525	7.40	3,050	9.20	5,060
3.90	473	5.70	1,600	7.50	3,150	9.30	5,180
4.00	525	5.80	1,675	7.60	3,250	9.40	5,300
4.10	579	5.90	1,750	7.70	3,350	9.50	5,420
4.20	635	6.00	1,825	7.80	3,460	9.60	5,540
4.30	692	6.10	1,905	7.90	3,570	9.70	5,660
4.40	750	6.20	1,985	8.00	3,680	9.80	5,780
4.50	810	6.30	2,065	8.10	3,790	9.90	5,900
4.60	870	6.40	2,145	8.20	3,900	10.00	6,020
4.70	930	6.50	2,225	8.30	4,010		

The above table is applicable only for open channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 3.3 feet and 7.7 feet. Beyond the limits of the table the discharge is only approximate.

Estimated monthly discharge of Black River at Neillsville, Wis., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
April 6-30	3,900	177	1,036
May	6,910	267	1,768
June	23,060	205	3,840
July	4,120	80	884
August	635	60	229
September	4,340	80	918
October	2,570	20	750
November	870	205	392
December	635	150	292

WISCONSIN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Wisconsin River, the largest stream in the State of Wisconsin, rises in Lac Vieux Desert, a sheet of water about 10 square miles in area lying directly on the line separating the upper peninsula of Michigan from Wisconsin, and enters the Mississippi just below Prairie du Chien. The river flows southward for 300 miles to the city of Portage; it then turns sharply and flows west and southwest for the remainder of the distance to its mouth. Its drainage basin, 12,280 square miles in extent, has an average width of about 50 miles and is 225 miles long. From source to mouth the distance by water is approximately 400 miles. The stream lies for the most part in the eastern half of the basin, and below the bend at Portage it flows within about 10 miles of its southern edge.

The country drained is rolling, and in places decided ridges break the surface. In the headwater region are many lakes and tamarack swamps, and all the way down to Portage there is more or less swamp land between the ridges. The wooded (pine) country extends from the Michigan boundary line down to within 40 miles, by river, of the city of Portage. Below that point the pine disappears, and a semiprairie region gradually takes the place of the woods. In the southern part of the basin the Baraboo ranges of quartzite pass east and west from 400 to 700 feet above the surrounding country, and the bluffs along the lower river, especially on the south side, form prominent ramparts to the valley. Back from these the land is level or undulating.

The elevation of the headwaters is 1,532 feet above the sea, and that of the mouth about 600 feet. Hence in a course estimated to be 407 miles the river falls 932 feet, or about 2.29 feet per mile. The most rapid part is in the upper portion of the stream, and here are the available water powers. At the rapids the river flows over a rocky bed, but at intermediate places the bed is laraely made up of sand, gravel, and bowlders.

Owing to the form of the basin and the position of the river in it there are no very large tributaries. The wooded character of all the upper portion of the drainage area aids in maintaining the flow of the stream during the dry and cold seasons and makes the Wisconsin one of the most uniform in flow of all the large tributaries of the Mississippi.

WISCONSIN RIVER AT MERRILL, WIS.

This station was established November 17, 1902. It is located on the highway bridge in the city of Merrill, three blocks from the Lincoln County court-house, one-half mile from the Chicago, Milwaukee and St. Paul Railway station, and 1,000 feet below the dam of the electric-power house.

The channel is straight from the dam to the bridge and for about 400 feet below. It is about 300 feet wide at low stages and 400 feet at high water. Both banks are high and do not overflow. The velocity is rapid and the surface rough. The station is so near the dam that at high stages the velocity is affected. It is possible that the bed of the stream may be subject to slight change, though it is of rock and gravel and is very rough. Prairie River enters about one-half mile above the station, and there is an island about 600 feet below.

Discharge measurements are made from the two-span highway bridge, to which the chain gage is fastened. Each span of the bridge is 175 feet in length. The initial point for soundings is a nail marked "0" in the footboard at the left end of the bridge opposite the center of the iron hand-rail post.

The gage was read during 1905 by A. F. Lueck. Originally a vertical gage was fastened to the mill abutment. June 17, 1903, a chain gage was established on the bridge and made to read the same as the old gage at the mill. It is fastened to the guard timber on the downstream side, and the zero is marked by a brass screw driven into the guard timber. The fall of the water from the old gage to the new is 2.70 feet when the water is at high stage. The length of the chain from the end of the weight to the marker is 23.68 feet. The bench mark is a cross cut in the sandstone rock in the bridge seat of the abutment nearest the city; its elevation above the zero of the gage is 16.25 feet. This bench mark is 18.28 feet below the United States bench mark located at the corner of the engine house opposite the city hall.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, p 170; 98, pp 190-191; 128, pp 25-26.
Discharge: 83, p 170; 98, p 191; 128, p 26.
Discharge, monthly: 128, p 28.
Gage heights: 83, p 170; 98, p 192; 128, p 27.
Rating table: 128, p 27.

Discharge measurements of Wisconsin River at Merrill, Wis., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 10	S. K. Clapp	334	2,189	3.84	7.80	8,396
May 26	do	324	1,679	2.69	6.25	4,519
June 10	M. S. Brennan	334	2,334	4.06	8.17	9,478
July 10	do	332	1,596	2.73	6.48	4,357

Daily gage height, in feet, of Wisconsin River at Merrill, Wis., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.2	5.25	5.35	8.9	5.15	5.8	7.4	5.05	6.1	6.2	6.2	5.2
2	4.95	5.0	5.35	8.8	5.7	5.7	7.3	5.45	6.2	6.0	6.3	5.7
3	5.2	4.9	5.2	9.2	6.2	5.9	7.5	5.35	6.15	6.2	5.6	5.6
4	5.7	5.15	5.4	8.9	6.1	5.5	7.6	5.35	6.7	6.0	5.25	5.8
5	5.35	5.5	5.25	8.8	6.25	7.6	8.0	5.95	6.7	6.05	5.8	5.4
6	5.4	5.35	5.35	8.8	6.4	10.4	8.2	6.1	6.25	6.0	5.35	5.25
7	5.2	5.15	5.55	8.8	6.45	10.0	7.7	6.85	6.0	5.3	5.1	5.55
8	5.45	5.25	5.15	8.2	7.2	9.0	7.8	6.0	6.25	5.3	5.55	5.55
9	5.15	5.1	5.2	8.6	6.7	9.0	8.0	6.25	6.1	4.3	5.45	5.35
10	5.05	5.4	5.65	7.8	6.45	8.4	7.2	6.4	6.3	4.9	5.9	5.75
11	5.35	5.2	5.45	7.4	6.95	8.5	6.85	6.05	6.15	6.15	5.8	5.7
12	5.5	4.95	5.05	7.2	7.2	8.4	7.05	5.75	6.3	6.8	5.15	5.55
13	5.5	5.2	5.45	7.4	6.9	7.8	6.2	6.0	6.65	6.45	5.3	5.6
14	5.9	5.25	4.7	7.0	7.4	7.8	6.3	6.15	6.4	6.55	5.0	5.6
15	6.0	5.15	4.7	6.9	7.6	7.6	6.8	5.9	6.05	5.9	5.2	5.35
16	5.95	5.5	4.95	7.2	7.6	8.1	6.5	6.05	6.4	6.15	5.65	5.7
17	5.75	5.7	5.05	7.4	7.8	10.4	6.3	5.9	6.6	5.85	5.7	6.15
18	5.85	5.65	5.25	7.0	7.8	10.6	6.55	6.4	6.45	6.25	5.75	5.5
19	5.65	5.55	5.25	6.45	7.5	10.6	5.05	6.25	6.9	6.65	5.85	5.6
20	5.15	5.35	5.25	6.45	7.3	9.6	5.65	6.2	7.35	6.85	5.45	5.65
21	5.15	4.3	5.5	6.45	7.0	9.2	6.45	5.9	6.7	6.7	5.75	5.75
22	5.6	5.2	4.95	6.05	6.75	8.6	6.0	6.8	7.3	6.7	5.75	5.75
23	5.8	5.75	4.95	5.95	6.8	8.5	5.5	6.5	6.9	6.8	5.75	5.45
24	6.05	5.8	5.35	5.6	6.4	8.0	5.4	4.8	6.8	6.15	5.6	5.55
25	6.15	5.6	4.55	5.75	6.45	7.6	5.2	5.55	6.5	6.3	5.7	5.9
26	5.85	5.15	5.75	6.2	6.3	6.9	5.1	6.35	6.25	6.7	5.2	6.25
27	5.85	5.65	6.05	5.9	6.35	7.6	5.65	6.4	6.55	6.55	4.8	5.9
28	5.25	5.35	7.4	5.65	6.35	7.5	5.8	6.25	6.15	6.9	5.15	5.6
29	5.1	.....	8.0	5.95	6.25	6.75	5.6	5.75	5.95	6.5	5.65	5.85
30	5.05	.....	8.6	5.45	6.25	7.05	5.75	6.0	6.45	5.7	5.5	5.7
31	5.15	.....	8.5	.....	6.0	.....	4.3	6.8	.....	5.8	.....	5.4

NOTE.—No ice record at this station.

WISCONSIN RIVER NEAR NECEDAH, WIS.

This station was established December 2, 1902. It is located on the highway toll bridge 3 miles east of Necedah, Wis., and 3 miles from the Chicago, Milwaukee and St. Paul and the Chicago and Northwestern railway stations.

The general direction of the channel is straight for 2,000 feet above and below the station. The width at ordinary stages is about 325 feet, broken by one pier. The right bank is high and rocky; the left overflows, making the width of the channel from 500 to 600 feet. During the spring flood of 1903 the water overflowed the turnpike. The right side of the bed of the stream is rocky, but the remainder is sandy and is liable to shift. The velocity is rapid and rather poorly distributed on account of the ice breaker above the middle pier and the variation in the width of the channel just above the bridge. Yellow River flows into the Wisconsin about 4 miles below the station. There are islands both above and below the station, but they are several hundred feet away.

Discharge measurements are made from the two-span highway bridge to which the gage is attached. The initial point for soundings is a point over the right abutment, marked zero with paint.

A standard chain gage, which was read during 1905 by W. F. Bingman, is fastened to the upstream side of the bridge. The length of the chain from the end of the weight to the marker is 26.87 feet. The gage is referred to bench marks as follows: (1) A nail in the top of a red-oak stump, 2.5 feet in diameter, about 60 feet south of the center of the roadbed and about 50 feet from the river at ordinary stages; elevation above zero of gage, 12.99 feet. (2) A nail in the root of a large cottonwood tree 280 feet south of the bridge and about 80 feet from the river; elevation above gage zero, 11.90 feet. (3) A cross on a large sandstone rock 70 feet south of the center of the roadway and 15 feet west of the water's edge on the west bank of the river; elevation above zero of gage, 20.36 feet. Bench marks Nos. 1 and 2 are on the east side of the river.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, p 169; 98, p 187; 128, pp 28-29.
Discharge: 83, p 169; 98, p 188; 128, p 29.
Discharge, monthly: 98, p 190; 128, p 31.
Gage heights: 83, p 169; 98, pp 188-189; 128, p 30.
Rating table: 98, pp 189-190; 128, p 30.

Discharge measurements of Wisconsin River near Necedah, Wis., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 4	S. K. Clapp	.....	5,777	5.07	12.33	29,290
May 25	do	317	4,137	3.23	7.65	13,350
June 12	M. S. Brennan	437	6,017	4.99	12.90	30,050
August 9	do	314	3,486	2.40	6.85	9,[illegible]

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	13.3	5.95	6.5	7.3	5.5	5.9	6.0	5.8	5.4
2	.....	.....	.....	13.3	6.1	6.4	7.3	5.3	6.0	5.7	5.5	5.1
3	.....	.....	.....	12.8	6.1	6.4	7.5	5.2	6.2	5.6	5.3	5.1
4	.....	6.0	5.7	12.4	6.0	6.3	7.5	5.2	6.0	5.5	5.4	5.3
5	.....	.....	.....	11.9	6.0	7.7	7.5	5.6	6.1	5.4	5.5	5.6
6	.....	.....	.....	11.6	6.5	8.3	8.1	5.3	6.1	5.4	5.4	5.8
7	6.0	.....	.....	11.8	6.6	11.0	8.6	5.4	6.55	5.4	5.4	6.8
8	.....	.....	.....	11.9	6.7	12.5	9.1	6.6	6.2	5.4	5.4	6.5
9	.....	.....	.....	11.4	6.9	15.0	8.7	6.9	5.7	5.2	5.5	6.2
10	.....	.....	.....	10.6	7.0	17.0	8.3	7.1	5.6	5.3	5.5	8.6
11	.....	.....	6.15	9.9	7.0	16.0	7.6	6.7	5.5	5.0	5.6	8.8
12	.....	.....	.....	9.3	7.5	13.0	7.4	6.5	5.3	4.9	5.5	8.4
13	.....	6.0	.....	9.0	8.3	11.9	7.0	6.7	5.4	4.7	5.5	7.7
14	6.0	.....	.....	8.6	8.5	11.5	6.6	6.4	5.5	4.7	5.5	7.7
15	.....	.....	.....	8.4	8.3	11.2	6.7	6.2	5.5	5.1	5.3	7.6
16	.....	.....	.....	8.0	8.6	10.4	6.5	5.9	5.3	5.1	5.3	7.6
17	.....	.....	.....	7.8	9.3	9.7	6.3	6.0	5.4	5.3	5.1	7.8
18	.....	.....	.....	7.5	9.8	9.5	6.5	5.9	5.5	5.3	5.2	7.3
19	.....	.....	.....	7.1	9.8	9.6	6.3	5.8	6.9	5.6	5.2	7.3
20	.....	6.0	.....	6.7	9.7	11.2	6.3	5.6	7.4	5.6	5.3	7.3
21	6.1	.....	5.0	6.6	9.3	12.4	6.3	5.5	8.2	5.8	5.2	7.2
22	.....	.....	5.0	6.6	8.8	12.3	6.1	5.7	8.4	6.3	4.9	7.1
23	.....	.....	5.0	6.5	8.3	11.0	5.9	5.7	8.4	6.7	4.9	7.1
24	.....	.....	5.3	6.4	8.0	9.8	5.7	5.5	7.8	7.0	4.9	6.8
25	.....	6.0	5.6	6.3	7.7	8.8	5.75	5.7	7.2	6.8	4.8	6.3
26	.....	.....	6.8	6.0	7.2	8.3	6.0	5.9	6.8	6.7	5.1	6.3
27	.....	.....	7.1	6.15	7.1	8.0	5.5	5.3	6.5	6.6	5.1	7.1
28	6.0	.....	8.3	6.0	7.0	7.8	5.1	5.0	6.0	6.4	5.5	6.5
29	.....	.....	9.3	5.95	6.7	7.4	5.3	5.8	5.9	6.2	5.3	6.4
30	.....	.....	10.7	5.9	6.8	7.0	5.1	5.7	6.0	6.2	5.4	6.3
31	.....	.....	.....	.....	6.6	.....	5.3	5.7	.....	6.0	.....	6.1

NOTE.—River frozen over January 1 to March 20. Gage heights are to water surface in a hole in the ice. Thickness of ice, 2 to 2.5 feet. No ice record for December.

Station rating table for Wisconsin River near Necedah, Wis., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	1,800	5.50	5,130	7.00	9,400	9.80	17,800
4.10	2,000	5.60	5,380	7.20	10,000	10.00	18,400
4.20	2,200	5.70	5,640	7.40	10,600	10.50	19,900
4.30	2,400	5.80	5,900	7.60	11,200	11.00	21,400
4.40	2,600	5.90	6,170	7.80	11,800	11.50	23,610
4.50	2,810	6.00	6,440	8.00	12,400	12.00	25,860
4.60	3,020	6.10	6,720	8.20	13,000	12.50	28,230
4.70	3,240	6.20	7,010	8.40	13,600	13.00	30,750
4.80	3,460	6.30	7,300	8.60	14,200	13.50	38,450
4.90	3,690	6.40	7,600	8.80	14,800	14.00	46,200
5.00	3,920	6.50	7,900	9.00	15,400	15.00	61,800
5.10	4,150	6.60	8,200	9.20	16,000	16.00	77,500
5.20	4,390	6.70	8,500	9.40	16,600	17.00	93,300
5.30	4,630	6.80	8,800	9.60	17,200	18.00	109,200
5.40	4,880	6.90	9,100				

The above table is applicable only for open-channel conditions. It is based on 23 discharge measurements made during 1902–1905. It is well defined between gage heights 4.5 feet and 10.5 feet. The table has been extended beyond these limits. From gage height 6.3 feet to 11 feet the rating curve is a tangent, the difference being 300 per tenth. Above 11 feet the bank overflows, which causes the discharge to increase at a greater rate per foot.

Estimated monthly discharge of Wisconsin River near Necedah, Wis., for 1905.

[Drainage area, 5,800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 21-30	20,500	3,920	9,037	1.56	0.58
April	35,370	6,170	15,790	2.72	3.04
May	17,800	6,305	11,060	1.91	2.20
June	93,300	7,300	23,320	4.02	4.48
July	15,700	4,150	8,711	1.50	1.73
August	9,700	3,920	6,099	1.05	1.21
September	13,600	4,630	7,419	1.28	1.43
October	9,400	3,240	5,748	.991	1.14
November	5,900	3,460	4,667	.805	.898
December	14,800	4,150	8,888	1.53	1.76

NOTE.—No estimate for ice period.

WAPSIPINICON RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Wapsipinicon River rises in Mower County, Minn., and flows southeastward, entering the Mississippi near Shafton, Scott County, Iowa. Its total drainage area is 2,304 square miles.

The river is generally fairly constant in flow, though its headwaters are sometimes low. As a rule, its banks are moderately high and the stream is well confined. There are numerous small power sites on this stream at Toronto, Oxford Mills, Newport, Anamosa, Central City, Troy Mills, Quasqueton, Independence, and Littleton. At several of these points, notably at Anamosa, there are good opportunities for building dams.

WAPSIPINICON RIVER AT STONE CITY, IOWA.

This station was established August 19, 1903. It is located at the highway bridge just above the Chicago, Milwaukee and St. Paul Railway bridge and near the Dearborn stone quarry.

The channel is straight for about 400 feet above and below the station, but the river makes abrupt turns at both ends of this section. Both banks are high and not subject to overflow. The bed of the stream is solid rock and sand and is permanent. The channel is broken by one pier and the current velocity is moderate. There is a dam at Waubeck, 4 miles above the station, and another at Anamosa, the same distance below.

Discharge measurements are made from the two-span highway bridge, which has a length of 225 feet. The initial point for soundings is the end of the lower chord on the upstream side of the bridge at the left bank.

A standard chain gage, which was read during 1905 by Frank Dearborn, is attached to the guard rail on the upstream side of the bridge. The length of the chain from the end of the weight to the marker is 36.40 feet. The gage is referred to bench marks as follows: (1) The east end of the south rail west of the first switch east of the railroad station at Stone City; elevation, 815.08 feet above sea level and 38.75 feet above gage datum. (2) A cross on the northwest corner of the middle pier of the highway bridge at which the station is located; elevation, 31.09 feet above gage datum and 807.42 feet above sea level. The center of the gage pulley has an elevation of 35.58 feet above gage datum and 811.91 feet above sea level. The top of the lower chord, upstream side, at the first cross girder east of the pier, is 31.75 feet above gage datum. The elevations of the bench marks above sea level have been determined by the Chicago, Milwaukee and St. Paul Railway levels.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 19; 130, pp 55-56.
Discharge: 99, p 20; 130, p 56.
Discharge, monthly: 99, p 21; 130, p 58.
Gage heights: 99, p 20; 130, p 57.
Rating table: 99, p 20; 130, p 58.

Discharge measurements of Wapsipinicon River at Stone City, Iowa, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 25	M. S. Brennan	170	1,514	3.12	9.81	4,718
April 27	do	143	521	1.11	3.95	579
May 23	Hanna and Hoyt	148	750	2.22	5.74	1,667
June 22	F. W. Hanna	148	711	2.18	5.48	1,547
July 18	Hanna and Clapp	140	420	1.35	3.64	568
August 9	F. W. Hanna	118	276	.73	2.87	202
September 25	M. S. Brennan	138	328	.88	3.08	289
October 24	do	140	363	1.00	3.30	364

Daily gage height, in feet, of Wapsipinicon River at Stone City, Iowa, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			3.05	5.4	3.6	4.6	4.4	3.2	3.33	2.76	2.92	4.75
2		2.54	3.1	5.0	3.55	5.8	4.2	3.26	3.2	2.72	2.9	4.35
3			3.18	4.8	3.5	6.3	4.1	3.22	3.12	2.72	2.83	.....
4			3.45	4.7	3.42	5.4	5.5	3.14	3.06	2.72	2.8	.....
5			3.9	4.5	3.35	5.05	6.2	3.05	3.02	2.72	2.92	.....
6	2.3		3.65	4.3	3.35	4.75	6.5	3.0	2.95	2.7	3.1	4.3
7			3.9	4.2	3.55	4.45	6.8	2.98	2.92	2.68	3.44	.....
8			4.1	4.1	3.55	4.2	5.6	2.9	2.9	2.66	3.55	.....
9			4.95	3.95	3.42	4.05	5.05	2.84	2.86	2.64	3.64	.....
10			5.4	3.9	3.55	4.0	4.8	2.76	2.86	2.62	3.52	.....
11		2.42	6.2	3.75	3.9	3.8	4.2	2.65	2.82	2.64	3.48	.....
12	2.3		7.0	3.7	5.3	3.7	4.35	2.58	2.78	2.61	3.38	.....
13			7.8	3.7	6.2	3.6	4.4	2.52	2.75	2.58	3.3	3.1
14			8.1	3.65	6.3	3.6	4.3	2.48	2.72	2.6	3.2	.....
15			8.3	3.6	7.1	3.5	3.8	2.6	2.8	2.63	3.15	.....
16			8.0	3.55	7.6	3.45	3.7	3.04	2.73	2.61	3.1	.....
17			7.8	3.4	7.9	3.4	3.55	3.36	2.71	2.82	3.08	.....
18			7.3	3.34	8.2	4.35	3.65	3.45	2.72	3.15	3.03	.....
19	2.42		8.7	3.3	7.8	4.9	3.6	3.4	3.0	3.13	3.0	.....
20			9.1	3.32	7.4	4.4	3.6	3.32	2.98	3.4	2.96	3.02
21		2.45	11.0	3.38	6.8	4.7	4.1	3.2	3.6	3.46	2.93	.....
22			11.7	4.0	6.5	5.5	5.2	3.6	3.6	3.42	2.9	.....
23			12.3	3.8	5.8	5.6	6.1	3.12	3.35	3.35	2.91	.....
24			10.8	3.7	5.4	5.4	5.4	3.1	3.15	3.31	2.9	.....
25			9.9	3.8	5.1	5.2	4.4	3.04	3.02	3.22	2.98	.....
26		2.8	8.8	3.85	4.7	5.2	3.95	2.96	2.9	3.15	3.02	2.74
27	2.48	2.78	8.4	3.95	4.3	5.1	3.7	3.85	2.82	3.15	3.04	.....
28		2.8	7.6	3.9	4.1	4.9	3.6	4.05	2.9	3.08	3.25	.....
29			7.0	3.8	4.0	4.65	3.45	3.9	2.8	3.03	3.4	.....
30			6.4	3.65	4.25	4.5	3.33	3.7	2.8	3.0	5.3	.....
31			5.8	.....	4.4	.....	3.25	3.5	.....	3.0	.....	.....

NOTE.—River frozen over January 1 to March 15. Also December 1-31. Gage heights are to water surface in a hole cut in the ice. Thickness of ice, 0.9 foot to 1.9 feet during January and February. Average thickness for December, 0.4 foot.

Station rating table for Wapsipinicon River at Stone City, Iowa, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	40	3.30	370	4.60	1,020	6.60	2,270
2.10	50	3.40	417	4.70	1,075	6.80	2,410
2.20	63	3.50	467	4.80	1,130	7.00	2,550
2.30	78	3.60	518	4.90	1,185	7.20	2,690
2.40	95	3.70	570	5.00	1,240	7.40	2,835
2.50	115	3.80	620	5.20	1,350	7.60	2,985
2.60	137	3.90	670	5.40	1,470	7.80	3,140
2.70	162	4.00	720	5.60	1,600	8.00	3,300
2.80	189	4.10	770	5.80	1,730	8.50	3,700
2.90	218	4.20	820	6.00	1,860	9.00	4,100
3.00	250	4.30	870	6.20	1,990	9.50	4,500
3.10	286	4.40	920	6.40	2,130	10.00	4,900
3.20	326	4.50	970				

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1904-5. It is well defined between gage heights 2.7 feet and 5.7 feet. The table has been extended beyond these limits, being based on one measurement at 9.8 feet. Below 2.7 feet the table is uncertain.

Estimated monthly discharge of Wapsipinicon River at Stone City, Iowa, for 1905.

[Drainage area, 1,308 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 16-31	6,740	1,730	3,953	3.02	1.80
April	1,470	370	689	.527	.588
May	3,460	394	1,396	1.07	1.23
June	2,060	417	1,044	.798	.899
July	2,410	348	995	.761	.877
August	745	111	330	.252	.290
September	518	165	251	.192	.214
October	447	133	235	.180	.208
November 1 to 29	539	189	306	.234	.252

NOTE.—No estimate for ice period.

ROCK RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Rock River rises in the southeastern part of Wisconsin, flows south and southwest, and enters the Mississippi just below Rock Island, Ill. Its length is 286 miles. Of the total drainage area (10,973 square miles), 5,653 square miles are in Wisconsin and 5,320 in Illinois. The length of the basin is 175 miles; its greatest width is near the Wisconsin-Illinois State line, where for 20 miles or more it averages about 80 miles; above the boundary it averages 40 or 50 miles in width, while below, in Illinois, it narrows rapidly.

In the upper part of its course the river flows rather toward the eastern side of the basin, but near the State line it approaches the center, and finally flows decidedly near the western boundary of its drainage area. The total fall of the stream, distributed with comparative uniformity throughout its length, is 340 feet, an average of 1.2 feet per mile.

The country drained is undulating and comprises large expanses of unbroken prairie, groves, and extensive bodies of timber, swamp, and lake.

ROCK RIVER AT ROCKTON, ILL.

This station was established May 13, 1903. It is located at the village highway bridge, one-half mile from the Chicago, Milwaukee and St. Paul Railway station, 1 mile below the dam, and three-fourths of a mile below the junction of Pecatonica River with Rock River.

The channel is straight for 2,000 feet above and 1,000 feet below the station, is about 565 feet wide between bridge abutments, and is broken by four piers. The bed of the stream is composed of rocks and gravel. The current is swift. There are small islands a short distance above and immediately below the station.

Discharge measurements are made from the upstream side of the five-span highway bridge to which the gage is attached. The initial point for soundings is the face of the abutment on the left end of the bridge.

The chain gage, which was read during 1905 by O. T. Bartholomew, is located on the first span from the left end of the bridge, downstream side. The length of the chain is 26.45 feet. The gage is referred to bench marks as follows: (1) A hammered cross on the top stone of the left abutment, about 1 foot from the bridge shoe and 1 foot from the south edge; elevation above gage datum, 16.85 feet. (2) Top of west end of south rail of railroad track, 250 feet north of the north end of the bridge, at a point where the sidewalk on the west side of the street crosses the track; elevation above gage datum, 16.49 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey, as follows:

Description: 98, pp 193, 195-196; 128, pp 31-32.
Discharge: 98, pp 194, 196; 128, p 32.
Discharge, monthly: 98, p 195; 128, p 34.
Gage heights: 98, pp 194, 196; 128, p 33.
Rating table: 98, p 195; 128, p 33.

Discharge measurements of Rock River at Rockton, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 23	Brennan and Hanna	516	4,650	3.82	10.37	17,770
April 29	M. S. Brennan	503	1,524	3.52	4.42	5,361
June 29	do	503	1,530	3.37	4.44	5,152
August 28	do	482	1,012	3.28	3.20	3,324
September 15	do	460	860	3.24	2.88	2,783

Daily gage height, in feet, of Rock River at Rockton, Ill., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	[a] 3.1	4.0	10.1	4.2	4.3	4.3	2.8	2.8	2.3	2.6	3.5
2	3.8	3.2	5.0	9.4	4.1	4.25	4.3	2.75	2.95	2.05	2.6	3.5
3	4.55	[a] 3.2	5.4	8.9	3.8	4.2	4.3	2.7	3.85	2.2	2.7	3.0
4	3.9	3.15	6.2	8.7	3.8	4.2	4.1	2.65	3.4	2.2	2.6	3.2
5	3.65	3.15	6.1	8.4	3.6	4.3	4.0	3.15	3.5	2.15	2.65	3.1
6	3.45	3.1	5.8	8.3	3.65	5.0	3.9	3.1	3.45	2.2	3.0	3.15
7	3.3	3.25	5.7	8.1	3.6	4.85	4.0	3.0	3.4	2.15	2.9	3.05
8	3.5	3.25	5.5	7.8	3.55	4.9	4.05	3.0	3.4	2.1	3.1	3.05
9	3.5	3.25	5.5	7.6	3.4	5.1	3.95	2.75	3.3	1.9	3.1	3.0
10	4.2	3.25	6.4	7.4	3.55	5.3	3.95	2.7	3.3	2.0	3.15	3.0
11	4.0	3.3	6.2	7.2	3.95	5.2	4.0	2.65	3.4	2.0	3.0	3.1
12	4.1	3.3	5.6	6.8	5.8	5.4	4.05	2.6	3.15	2.1	2.8	2.95
13	3.75	3.4	5.6	6.5	6.0	5.4	4.2	2.5	3.05	2.05	2.8	2.85
14	3.85	3.15	5.5	6.3	6.4	5.4	4.2	2.8	2.9	2.1	3.0	2.95
15	4.0	3.2	5.3	6.0	7.0	5.3	4.1	2.65	2.9	2.05	2.75	2.75
16	3.7	3.2	5.2	5.8	7.3	5.3	4.0	2.6	2.8	2.05	2.7	2.7
17	3.8	3.25	5.0	5.6	6.9	5.3	3.7	2.7	2.75	2.2	2.7	2.75
18	3.5	3.35	7.1	5.3	6.5	5.4	3.55	2.45	2.9	2.5	2.7	2.5
19	3.35	3.35	8.2	5.2	6.3	5.3	3.35	2.61	2.7	4.1	2.7	2.65
20	3.3	3.15	8.0	4.9	6.4	5.1	3.4	3.3	2.55	4.3	2.75	2.6
21	3.15	3.3	8.6	5.2	5.9	5.2	3.3	3.1	2.5	4.0	2.65	2.6
22	3.2	3.35	9.2	5.3	5.6	5.2	3.2	2.75	2.5	3.85	2.7	2.6
23	3.05	3.5	10.2	5.1	5.3	5.3	3.1	2.7	2.5	3.6	2.75	2.6
24	3.1	3.35	10.8	4.9	5.1	5.2	3.1	2.7	2.5	3.45	2.7	2.65
25	3.15	3.3	11.1	4.7	4.7	5.0	3.1	2.65	2.3	3.4	2.7	2.3
26	3.25	3.5	11.4	4.5	4.75	4.7	2.8	3.1	2.5	3.35	2.5	2.65
27	3.2	3.4	11.4	4.5	4.7	4.6	2.8	3.1	2.45	3.2	2.5	2.8
28	3.1	3.65	11.0	4.45	4.6	4.55	2.85	3.3	2.4	3.2	2.75	2.6
29	3.2	.....	11.0	4.35	4.6	4.4	3.1	3.3	2.3	3.05	3.15	3.05
30	3.0	.....	10.9	4.1	4.5	4.2	3.1	3.0	2.35	3.05	3.1	4.6
31	3.0	.....	10.7	.....	4.5	.....	2.95	2.85	.....	2.95	.....	3.5

[a] Gage heights interpolated.

NOTE.—Ice conditions uncertain during January and February. Partial ice conditions during December. Discharge applied as for open channel.

Station rating table for Rock River at Rockton, Ill., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	1,350	3.00	2,775	3.90	4,365	4.80	6,180
2.10	1,470	3.10	2,935	4.00	4,555	4.90	6,400
2.20	1,600	3.20	3,105	4.10	4,745	5.00	6,620
2.30	1,740	3.30	3,280	4.20	4,940	5.10	6,840
2.40	1,880	3.40	3,455	4.30	5,140	5.20	7,070
2.50	2,025	3.50	3,635	4.40	5,345	5.30	7,300
2.60	2,170	3.60	3,815	4.50	5,550	5.40	7,540
2.70	2,320	3.70	3,995	4.60	5,760	5.50	7,780
2.80	2,470	3.80	4,180	4.70	5,970	5.60	8,020
2.90	2,620						

The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1903-5. It is well defined between gage heights 2.4 feet and 6 feet. The table has been extended beyond these limits, being based on one measurement at 13.32 feet. Above gage height 5.6 feet the rating curve is a tangent, the difference being 250 per tenth.

Estimated monthly discharge of Rock River at Rockton, Ill., for 1905.

[Drainage area, 6,150 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January[a]	5,655	2,775	3,716	0.604	0.696
February[a]	3,905	2,935	3,250	.528	.550
March	22,520	4,555	12,890	2.10	2.42
April	19,270	4,745	10,050	1.63	1.82
May	12,270	3,455	6,748	1.10	1.27
June	7,540	4,940	6,491	1.06	1.18
July	5,140	2,470	3,916	.637	.734
August	3,280	1,952	2,538	.413	.476
September	4,272	1,740	2,642	.430	.480
October	5,140	1,240	2,411	.392	.452
November	3,020	2,025	2,463	.400	.446
December[a]	5,760	1,740	2,722	.443	.511
The year	22,520	1,240	4,986	.811	11.04

[a] See footnote for gage height table.

ROCK RIVER AT STERLING, ILL.

This station was established January 5, 1905. It is located on the new highway bridge in Sterling, Ill., about one-half mile below the dam of the Sterling Manufacturing Company.

The channel is straight for 1,000 feet above and 2,000 feet below the station. Both banks are high, alluvial, and not liable to overflow. The island between the two channels is partly submerged at very high water, but the road grade does not overflow. The bed of the stream is composed of gravel, is free from vegetation, and is permanent. There are two channels at all stages, each broken by the piers of the bridges. The current is swift.

Discharge measurements are made from the upstream side of the five-span bridge over the right channel and three-span structure over the left channel. The initial points for soundings are the inner faces of the concrete walls at the right ends of the upstream girders of the bridges in each channel.

A standard chain gage, which was read during 1905 by C. A. Staples, is placed on each channel. The length of the chain for the right (north) channel is 31.82 feet from the end of the weight to the outside edge of the ring; that for the left (south) channel is 32.10 feet. The gage in the right channel is referred to four bench marks as follows: (1) Extreme downstream corner of downstream wing of right abutment of bridge over right channel; elevation above gage datum, 20.78 feet. (2) Top of the girder at the gage pulley on the right channel; elevation above gage datum, 31.33 feet. (3) Extreme downstream corner of downstream wing of left abutment of bridge over left channel; elevation, 20.66 feet above gage datum. (4) Top surface of the girder at the gage pulley on the right channel; elevation, 31.11 feet above gage datum. The datum of the gage on the left channel is 0.48 foot below that on the right channel.

Discharge measurements of Rock River (north channel) at Sterling, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11 [a]	Hanna and Clapp	566	2,668	2.65	8.90	7.082
March 24	Hanna and Brennan	602	3,649	3.91	10.71	14,270
April 28	M. S. Brennan	536	1,608	2.74	7.09	4,398
June 16	F. W. Hanna	554	1,792	2.90	7.46	5,206
August 11	do	549	881	1.91	5.80	1,681
September 15	do	550	1,007	2.10	6.05	2,118

[a] One channel blocked with ice.

Daily gage height, in feet, of Rock River (north channel) at Sterling, Ill., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.05	7.25	10.7	7.05	6.95	6.85	6.05	5.9	5.7	5.98	5.93
2	.....	7.05	7.25	10.1	6.95	6.95	6.8	6.03	6.0	5.69	5.94	5.98
3	.....	7.05	9.3	9.9	6.9	6.9	6.8	5.84	6.05	5.6	5.92	6.05
4	.....	7.0	10.0	9.6	6.9	6.9	6.75	5.78	6.2	5.53	5.9	6.05
5	.....	7.0	9.8	9.4	6.55	6.9	6.7	5.73	6.3	5.51	5.84	6.1
6	6.5	7.0	9.7	9.1	6.5	8.7	6.7	5.7	6.3	5.49	5.8	6.05
7	6.6	7.0	9.6	9.0	6.3	8.6	6.65	5.76	6.4	5.42	5.77	6.1
8	6.9	6.9	9.3	8.9	6.25	7.8	6.6	5.84	6.5	5.42	5.74	6.1
9	7.1	6.9	9.3	8.7	6.25	7.8	6.65	5.82	6.6	5.4	5.74	6.1
10	7.8	6.9	9.3	8.7	6.4	7.8	6.65	5.8	6.7	5.4	5.73	6.0
11	7.8	6.9	9.2	8.5	9.8	7.9	6.65	5.78	6.65	5.38	5.71	6.0
12	7.1	7.0	8.0	8.3	10.6	7.7	6.65	5.76	6.6	5.36	5.72	5.98
13	7.1	7.0	7.9	8.3	10.4	7.8	6.65	5.84	6.6	5.36	5.7	5.98
14	7.1	7.0	7.9	8.2	10.2	7.7	6.7	5.82	6.6	5.34	5.7	5.98
15	7.1	7.0	7.9	8.1	9.7	7.6	6.75	5.78	6.55	5.3	5.74	5.94
16	7.1	7.0	7.9	7.7	9.7	7.45	6.7	5.77	6.5	5.28	5.7	5.92
17	7.1	7.0	8.5	7.7	9.7	7.7	6.6	5.75	6.4	5.22	5.68	5.81
18	7.1	7.0	9.2	7.6	9.9	7.6	6.55	5.64	6.4	5.18	5.66	5.81
19	6.65	7.05	11.6	7.5	8.9	7.4	6.55	5.45	6.35	5.17	5.68	5.8
20	7.1	7.05	11.6	7.5	8.7	7.45	6.5	5.5	6.3	5.23	5.7	5.78
21	7.1	7.05	9.8	7.5	8.5	7.25	6.35	5.6	6.25	5.3	5.73	5.76
22	7.1	7.05	9.8	7.55	8.0	7.2	6.2	5.67	6.15	6.35	5.74	5.72
23	7.1	7.1	9.8	7.5	7.8	7.2	6.15	5.72	6.0	6.5	5.78	5.72
24	7.1	7.1	10.7	7.5	7.2	7.15	6.15	5.76	5.95	6.5	5.79	5.74
25	7.05	7.1	10.9	7.5	7.1	7.1	6.15	5.78	5.88	6.3	5.82	5.71
26	7.2	7.2	11.0	7.5	7.0	7.0	6.1	5.78	5.86	6.3	5.82	5.72
27	7.2	7.2	11.0	7.5	7.0	6.95	5.99	5.84	5.76	6.3	5.81	5.72
28	7.2	7.2	10.9	7.2	7.05	6.9	5.96	5.48	5.72	6.25	5.8	5.7
29	7.0	.....	10.8	7.1	7.05	6.9	5.97	5.91	5.7	6.15	5.85	5.8
30	7.0	.....	10.7	7.05	7.05	6.85	5.9	5.91	5.68	6.0	5.9	5.82
31	7.0	.....	10.7	.....	6.95	.....	6.1	5.9	.....	6.0	.....	5.8

NOTE.—Channel frozen over January 10 to March 7.

Station rating table for Rock River (north channel) at Sterling, Ill., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.10	560	6.50	3,060	7.90	6,295	9.60	10,930
5.20	710	6.60	3,270	8.00	6,550	9.80	11,530
5.30	860	6.70	3,485	8.10	6,810	10.00	12,140
5.40	1,020	6.80	3,700	8.20	7,070	10.20	12,760
5.50	1,180	6.90	3,920	8.30	7,330	10.40	13,380
5.60	1,340	7.00	4,145	8.40	7,590	10.60	14,000
5.70	1,510	7.10	4,375	8.50	7,850	10.80	14,620
5.80	1,680	7.20	4,605	8.60	8,110	11.00	15,240
5.90	1,860	7.30	4,835	8.70	8,380	11.20	15,860
6.00	2,050	7.40	5,070	8.80	8,650	11.40	16,480
6.10	2,245	7.50	5,310	8.90	8,920	11.60	17,100
6.20	2,445	7.60	5,550	9.00	9,200	11.80	17,720
6.30	2,645	7.70	5,795	9.20	9,760	12.00	18,340
6.40	2,850	7.80	6,045	9.40	10,340		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 5.8 feet and 10.7 feet. This station is very accurately rated for 1905.

Discharge measurements of Rock River (south channel) at Sterling, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 11	Hanna and Clapp	286	1,534	2.38	9.13	3,645
March 24	Hanna and Brennan	300	2,186	3.63	10.98	7,934
April 28	M. S. Brennan	290	1,020	2.67	7.28	2,723
June 16	F. W. Hanna	284	1,068	2.89	7.59	3,087
August 11	do	272	589	2.21	5.76	1,300
September 15	do	278	635	2.01	6.04	1,274

Daily gage height, in feet, of Rock River (south channel) at Sterling, Ill., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.6	7.25	10.9	7.25	7.05	6.9	6.0	6.0	5.67	5.95	6.0
2	.....	6.6	7.25	10.3	7.1	6.8	6.9	5.98	6.1	5.66	5.9	6.05
3	.....	6.6	9.3	10.1	7.0	6.75	6.9	5.81	6.05	5.58	5.88	6.15
4	.....	6.6	10.0	9.8	7.0	6.8	6.85	5.78	6.2	5.51	5.85	6.15
5	6.4	6.0	10.5	9.6	6.6	6.8	6.8	5.72	6.3	5.49	5.82	6.15
6	6.5	6.0	10.5	9.4	6.5	8.85	6.8	5.7	6.3	5.45	5.78	6.2
7	6.6	6.0	9.0	9.3	6.3	8.6	6.75	5.76	6.4	5.37	5.72	6.2
8	6.4	6.5	9.0	9.3	6.3	7.5	6.75	5.84	6.5	5.35	5.7	6.2
9	6.9	6.45	9.0	9.0	6.3	7.45	6.7	5.82	6.6	5.33	5.72	6.2
10	6.6	6.5	9.0	9.0	6.4	7.45	6.7	5.8	6.7	5.32	5.7	6.1
11	7.1	6.5	9.0	8.8	10.3	7.6	6.7	5.78	6.7	5.32	5.68	6.1
12	7.1	6.3	8.4	8.6	10.9	7.8	6.7	5.72	6.65	5.3	5.7	6.1
13	7.1	6.15	8.4	8.6	10.8	8.0	6.7	5.76	6.65	5.31	5.69	6.1
14	7.15	6.1	8.3	8.5	10.6	7.9	6.75	5.77	6.65	5.3	5.68	6.05
15	7.4	6.9	8.3	8.4	9.9	7.8	6.8	5.74	6.6	5.15	5.7	6.05
16	7.4	6.1	8.2	7.9	9.9	7.7	6.8	5.7	6.55	4.95	5.65	6.0
17	7.4	6.1	8.5	7.9	9.9	7.6	6.7	5.68	6.5	4.88	5.64	5.91
18	7.4	6.1	9.3	7.8	9.5	7.6	6.6	5.59	6.45	4.85	5.6	5.95
19	7.0	6.05	11.8	7.7	9.0	7.6	6.6	5.54	6.4	4.85	5.62	5.9
20	6.75	6.05	11.8	7.6	8.9	7.6	6.5	5.61	6.35	5.19	5.64	5.88
21	6.75	6.05	10.8	7.7	8.6	7.55	6.25	5.7	6.3	5.28	5.65	5.88
22	6.7	6.05	10.6	7.7	8.2	7.4	6.15	5.75	6.2	6.3	5.65	5.84
23	6.8	6.1	10.6	7.7	8.0	7.4	6.15	5.79	6.05	6.5	5.68	5.83
24	6.8	6.1	11.4	7.7	7.55	7.35	6.15	5.82	5.97	6.5	5.7	5.9
25	6.75	6.1	11.2	7.7	7.5	7.25	6.15	5.9	5.9	6.3	5.72	5.89
26	6.8	7.05	11.3	7.7	7.45	7.2	6.1	5.92	5.82	6.3	5.72	5.9
27	6.8	7.2	11.2	7.7	7.4	7.1	5.95	5.98	5.74	6.3	5.72	5.88
28	6.8	7.2	11.2	7.4	7.3	7.05	5.95	6.0	5.7	6.25	5.72	5.86
29	6.6	.....	11.0	7.3	7.3	7.0	5.95	6.0	5.68	6.15	5.94	5.95
30	6.6	.....	10.9	7.25	7.3	6.95	5.85	6.0	5.66	5.98	5.97	5.96
31	6.6	.....	11.0	.....	7.0	.....	6.05	6.0	.....	5.95	.....	5.96

NOTE.—Channel frozen over January 15 to March 7.

Station rating table for Rock River (south channel) at Sterling, Ill., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.00	600	6.50	1,875	8.00	3,600	9.80	6,080
5.10	670	6.60	1,975	8.10	3,730	10.00	6,400
5.20	745	6.70	2,075	8.20	3,860	10.20	6,720
5.30	820	6.80	2,180	8.30	3,990	10.40	7,040
5.40	895	6.90	2,290	8.40	4,120	10.60	7,360
5.50	975	7.00	2,400	8.50	4,250	10.80	7,680
5.60	1,055	7.10	2,510	8.60	4,380	11.00	8,000
5.70	1,140	7.20	2,620	8.70	4,510	11.20	8,330
5.80	1,225	7.30	2,730	8.80	4,640	11.40	8,640
5.90	1,310	7.40	2,850	8.90	4,780	11.60	8,960
6.00	1,400	7.50	2,970	9.00	4,920	11.80	9,280
6.10	1,490	7.60	3,090	9.20	5,200	12.00	9,600
6.20	1,585	7.70	3,210	9.40	5,480	12.20	9,930
6.30	1,680	7.80	3,340	9.60	5,780	12.40	10,270
6.40	1,775	7.90	3,470				

The above table is applicable only for open channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 5.7 feet and 11 feet. This station is very accurately rated for 1905.

Estimated monthly discharge of Rock River[a] at Sterling, Ill., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
March 8-31	26,380	10,155	18,010
April	22,150	6,935	11,570
May	21,840	4,225	10,340
June	13,090	6,048	8,043
July	6,100	3,128	4,892
August	3,548	2,107	2,861
September	5,560	2,582	4,167
October	4,935	1,160	2,614
November	3,367	2,497	2,820
December	3,830	2,786	3,265

[a] North and south channels combined.

NOTE.—No estimate for ice period.

IOWA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Iowa River rises in north-central Iowa, flows in a southeasterly direction, and joins the Mississippi about 30 miles above Burlington. Its chief tributary is Cedar River, which rises in Minnesota and flows into the Iowa about 50 miles above the mouth of the latter. The total drainage area of the Iowa is 12,410 square miles, 4,470 square miles of this being tributary to it above its junction with Cedar River at Columbus Junction. Cedar River drains 7,597 square miles above its union with Iowa River.

The chief power plants in the Iowa basin are at Iowa City, Marshalltown, Cedar Rapids, Waterloo, and Cedar Falls, and from the standpoint of power development the Iowa River system is important.

IOWA RIVER AT IOWA CITY, IOWA.

This station was established June 1, 1903. It is located on the county bridge, directly west of the university grounds.

The channel is straight for about 1,600 feet above and below the station, is 316 feet wide between abutments, and is broken by one pier. The bed of the stream is of soft material, except near the bridge pier, and is slightly shifting. The right bank is high, somewhat rocky, and is not liable to overflow; the left does not overflow, owing to the road embankment. Both banks are covered with willows above ordinary high-water mark, which interfere with flood measurements. The current is moderately swift.

Discharge measurements are made from the upstream side of the two-span highway bridge at the foot of Burlington street, about 1,000 feet below the bridge at which the gage is located. The bridge is not quite at right angles to the direction of the current. The initial point for soundings is the inner face of the right abutment, at the west end of the bridge, and is marked zero on the bridge floor.

A standard chain gage, which was read during 1905 by Arthur G. Smith, was substituted on September 15, 1903, for the gage installed at the time of the establishment of the station, the length of chain being the same, 24.43 feet. On June 8, 1904, the length of the chain was changed to 26.48 feet, the gage datum remaining the same. The gage is referred to bench marks as follows: (1) Nail driven into base of an elm tree standing 16 feet northwest of bridge on which gage is located; elevation, 18.96 feet above gage datum, 61.01 feet above city datum, and 668.35 feet above sea level. (2) On the top stone just north of and against the northwest railing post of the bridge at which the gage is located; elevation, 22.67 feet above gage datum, 64.72 feet above city datum, and 672.06 feet above sea level. The city bench mark used for reference is on the north side of the base of a maple tree, one block east and one block and 40 feet south of the bridge at which the gage is located; elevation, 22.53 feet above gage datum, 64.58 feet above city datum, and 671.92 feet above sea level. The elevation above sea level was obtained from the levels of the Chicago, Rock Island and Pacific Railway. The bottom of the top handrail just above the pulley center has an elevation of 26.73 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 24-25; 130, p 59.
Discharge: 99, p 25; 130, p 60.
Discharge: monthly: 99, p 27; 130, p 61.
Gage heights: 99, pp 25-26; 130, p 60.
Rating table: 99, p 26; 130, p 61.

Discharge measurements of Iowa River at Iowa City, Iowa, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 26	M. S. Brennan	314	2,456	2.59	6.47	6,372
April 20	do	192	895	1.31	.82	1,176
May 22	Hanna and Hoyt	307	2,508	2.78	6.81	6,982
June 21	F. W. Hanna	206	1,239	1.98	2.35	2,458
July 17	Hanna and Clapp	193	1,040	1.53	1.10	1,590
August 8	F. W. Hanna	179	809	1.03	.15	833
September 26	M. S. Brennan	180	737	.88	− .28	646

Daily gage height, in feet, of Iowa River at Iowa City, Iowa, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			0.5	3.25	1.4	4.1	3.6	0.35	−0.35	−0.95	−0.05	0.9
2			.9	2.95	1.35	3.8	2.05	.45	− .4	− .95	− .05	.5
3			1.35	2.8	1.2	3.6	1.8	.45	− .6	− .9	.0	.5
4		− 0.9	3.5	2.5	1.1	3.5	2.65	.15	− .65	− .9	.0	− .2
5			2.7	2.3	.9	3.15	2.9	.2	− .7	−1.0	.1	.0
6			1.9	2.3	.8	2.9	2.8	.25	− .8	− .95	1.0	.5
7	−1.4		1.6	2.25	.65	2.6	2.65	.2	− .8	− .9	1.5	.6
8			1.65	2.25	.5	2.25	2.45	.15	− .75	−1.1	2.05	1.0
9			2.7	2.25	.55	2.15	2.4	.1	− .85	−1.05	1.6	.8
10			4.4	2.1	.85	7.6	2.35	.0	− .85	−1.05	1.5	1.3
11		−1.1	4.4	1.95	4.4	5.4	1.9	− .1	− .8	−1.0	1.4	.5
12			4.9	1.8	6.2	4.7	2.0	− .3	− .8	−1.3	1.4	.8
13			4.4	1.55	6.4	4.8	1.65	− .4	−1.0	−1.05	1.1	.7
14	−1.1		3.2	1.35	6.4	4.0	1.45	− .4	−1.1	− .8	1.1	.6
15			2.45	1.15	7.1	2.6	1.25	.4	− .85	− .75	1.0	.5
16			2.7	2.05	6.8	2.2	1.2	.35	− .95	− .5	.9	.3
17			3.35	.95	6.3	2.05	1.15	.35	− .9	− .2	.8	.0
18		− .9	2.4	.85	6.0	2.3	1.15	.2	− .9	2.05	.8	− .1
19			3.8	.8	6.4	3.05	.9	.0	− .2	1.75	.5	.0
20			6.3	.9	6.6	3.0	1.15	− .2	− .3	1.5	.5	.2
21	−1.2		3.8	2.1	6.8	2.5	2.6	− .35	.1	1.4	.5	− .3
22			4.6	1.6	6.8	2.15	3.0	.0	.5	1.0	.3	− .5
23			5.6	1.85	7.4	2.1	3.15	− .45	.4	.7	.3	.3
24			6.4	1.8	8.0	2.25	2.9	− .2	.05	.6	.6	− .2
25		1.0	6.5	1.8	7.8	2.25	2.15	− .1	− .2	.2	.7	− .7
26			6.4	2.1	7.1	1.95	1.5	− .2	− .25	.1	.8	.1
27	−1.1	− .4	6.1	1.95	6.0	1.55	1.15	.0	− .5	.1	.8	[a] − .2
28			5.1	1.7	5.2	1.35	.95	.5	− .6	.0	1.5	− .3
29			4.8	1.6	5.4	1.2	.85	.4	− .7	− .1	1.0	− .2
30			4.0	1.45	4.8	1.0	.65	.0	− .7	.0	.8	.0
31			3.6		4.4		.5	− .2		.0		.0

[a] Gage height interpolated.

NOTE.—River frozen January 1 to February 28, approximately. Gage heights are to water surface in a hole cut in the ice. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 7	−1.4	−1.3	0.7
January 14	−1.1	−1.05	.6
January 21	−1.2	−1.2	.8
January 28	−1.1	−1.0	1.2
February 4	− .9	− .7	1.2
February 11	−1.1	−1.0	1.3
February 18	− .9	− .7	1.2

Partial ice conditions during December.

Station rating table for Iowa River at Iowa City, Iowa, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
−1.50	230	0.30	916	2.20	2,190	7.00	7,150
−1.40	252	0.40	971	2.40	2,350	7.50	7,820
−1.30	276	0.50	1,028	2.60	2,520	8.00	8,540
−1.20	302	0.60	1,087	2.80	2,700	8.50	9,290
−1.10	330	0.70	1,148	3.00	2,890	9.00	10,040
−1.00	360	0.80	1,210	3.20	3,080	9.50	10,800
−0.90	392	0.90	1,274	3.40	3,270	10.00	11,600
−0.80	426	1.00	1,340	3.60	3,460	10.50	12,400
−0.70	462	1.10	1,410	3.80	3,650	11.00	13,220
−0.60	499	1.20	1,480	4.00	3,840	11.50	14,070
−0.50	538	1.30	1,550	4.20	4,030	12.00	14,920
−0.40	579	1.40	1,620	4.40	4,220	12.50	15,770
−0.30	622	1.50	1,690	4.60	4,410	13.00	16,640
−0.20	666	1.60	1,760	4.80	4,600	13.50	17,540
−0.10	712	1.70	1,830	5.00	4,800	14.00	18,440
0.00	760	1.80	1,900	5.50	5,350		
0.10	810	1.90	1,970	6.00	5,900		
0.20	862	2.00	2,040	6.50	6,500		

The above table is applicable only for open-channel conditions. It is based on 25 discharge measurements made during 1903–1905. It is well defined between gage heights −1.5 feet and +2.4 feet. The table has been extended beyond these limits, being based on three measurements near 7 feet and one near 14 feet gage height.

Estimated monthly discharge of Iowa River at Iowa City, Iowa, for 1905.

[Drainage area, 3,317 square miles.]

Month.	Discharge in second-feet			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	6,500	1,028	3,695	1.11	1.28
April	3,128	1,210	1,973	.595	.664
May	8,540	1,028	4,710	1.42	1.64
June	7,960	1,340	2,916	.879	.981
July	3,460	1,028	2,013	.607	.700
August	1,028	558	793	.239	.276
September	1,028	330	532	.160	.178
October	2,078	276	743	.224	.258
November	2,078	538	1,229	.371	.414
December	1,550	462	902	.272	.314

NOTE.—No estimate for January and February. Discharge for December applied as for open channel.

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

Cedar River, called also, in part of its course, Red Cedar River, rises in the southwestern part of Dodge County, Minn., flows southeastward across eastern Iowa to the northern part of Muscatine County, then turns abruptly to the southwest, and joins Iowa River in northern Louisa County.

The gaging station was established October 26, 1902. It is located at Cedar Rapids, Iowa, about 50 miles above the mouth of the river, and is near the city gas works and the plant of the Iowa Windmill and Pump Company.

The channel is straight for 800 feet above and below the station, is regular in cross section, and is about 400 feet wide. The right bank is high and will overflow at extreme stages only; the left is an earth embankment and will seldom overflow. At the First Avenue Bridge the channel is straight both above and below for several hundred feet, and is divided into five parts by the five-span Pratt truss bridge, its length between abutments being 714 feet. The banks are high and not liable to overflow. The bed of the stream is of rock and gravel and is permanent. The current is strong and direct.

Discharge measurements were originally made from a cable and car at a point just above the gage. At low stages the discharge at the cable station can be measured by wading. Since 1903 discharge measurements have been made from the upstream side of the First Avenue Bridge, about one-half mile upstream from the gage. The initial point for soundings is the inner upstream face of the left abutment. For the purpose of comparing soundings, the distance of the water surface below the top surface of the downstream hand rail at a point 1 foot west of the nineteenth hand rail post from the left abutment is measured.

The gage, which was read during 1905 by R. S. Toogood, consists of an inclined timber, graduated to read to vertical tenths and half-tenths feet. It is fastened to the right bank by posts set in the ground. The gage is referred to bench marks as follows: (1) A city bench mark at Williams & Hunting's office, on the north corner of Fifth avenue and West First street, marked by a triangle on the stone just north of the first iron post from the corner of the building; elevation above sea level, as determined by the city of Cedar Rapids from the level of the Northwestern Railway, 746.6 feet; elevation above gage datum, 23.57 feet. (2) Bolt driven into masonry foundation of east face of Iowa Windmill and Pump Company's building, on west bank of river, just north of Seventh avenue; elevation above sea level, 740.05 feet; elevation above gage datum, 17.02 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 21-22; 130, p 62.
Discharge: 99, p 22; 130, p 63.
Discharge, monthly: 99, p 24; 130, p 64.
Gage heights: 99, p 23; 130, p 63.
Rating table: 99, p 23; 130, p 64.

Discharge measurements of Cedar River at Cedar Rapids, Iowa, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 25	M. S. Brennan	643	3,775	3.94	7.09	14,860
April 27	do	595	1,395	2.04	3.95	2,845
May 23	Hanna and Hoyt	621	2,778	3.54	5.80	9,820
June 22	F. W. Hanna	632	2,656	3.32	5.58	8,806
July 18	Hanna and Clapp	599	1,596	2.18	4.05	3,473
August 9	F. W. Hanna	568	1,127	1.49	3.45	1,680
September 25	M. S. Brennan	566	1,086	1.28	3.31	1,393

Daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	3.45	3.55	4.9	3.75	5.1	4.05	3.65	3.45	3.25	3.3	3.2
2	3.0	3.5	3.55	4.7	3.7	5.6	4.35	3.65	3.4	3.2	3.3	3.15
3	3.4	3.6	3.55	4.65	3.75	5.5	4.6	3.55	3.35	3.2	3.3	3.0
4	3.2	3.45	3.6	4.55	3.7	5.2	4.7	3.7	3.35	3.15	3.3	2.9
5	3.25	3.45	4.05	4.45	3.65	4.9	4.8	3.6	3.3	3.15	3.4	2.9
6	3.3	3.5	3.95	4.45	3.6	4.65	5.0	3.7	3.3	3.15	3.65	3.0
7	3.3	3.55	4.2	4.5	3.55	4.45	5.4	3.6	3.25	3.15	3.9	3.2
8	3.2	3.55	4.85	4.5	3.5	4.3	5.4	3.5	3.25	3.1	3.8	3.55
9	3.1	3.6	5.3	4.4	3.55	4.3	5.3	3.45	3.25	3.1	3.7	3.7
10	3.3	3.55	6.2	4.35	3.6	4.3	5.1	3.4	3.25	3.05	3.65	3.65
11	3.4	3.5	7.0	4.3	4.6	4.2	4.9	3.4	3.2	3.05	3.65	3.5
12	3.3	3.5	6.8	4.2	5.2	4.05	4.8	3.4	3.2	3.1	3.6	3.35
13	3.35	3.55	6.3	4.1	5.0	4.5	4.7	3.35	3.2	3.1	3.6	3.35
14	3.3	3.55	5.7	4.0	5.4	4.4	4.4	3.4	3.25	3.1	3.55	3.3
15	3.25	3.6	5.4	3.9	5.7	4.5	4.3	3.45	3.25	3.1	3.55	3.25
16	3.4	3.55	5.15	3.9	6.1	4.55	4.2	3.6	3.25	3.25	3.5	3.2
17	3.3	3.6	5.4	3.85	6.3	4.8	4.1	3.6	3.25	3.4	3.5	3.15
18	3.35	3.7	5.8	3.8	7.0	4.7	4.05	3.6	3.25	3.4	3.45	3.2
19	3.4	3.75	6.4	3.85	7.8	5.1	3.95	3.5	3.35	3.65	3.45	3.25
20	3.45	3.8	6.7	3.8	7.9	5.2	4.65	3.5	3.65	3.55	3.4	3.2
21	3.4	3.75	7.4	3.95	7.1	5.5	4.7	3.4	3.65	3.55	3.4	3.2
22	3.45	3.7	8.3	4.05	6.4	5.6	4.4	3.3	3.5	3.55	3.4	3.3
23	3.4	3.65	9.0	4.0	5.8	5.8	4.2	3.35	3.45	3.55	3.35	3.35
24	3.35	3.65	8.2	4.0	5.4	5.7	4.05	3.3	3.4	3.55	3.35	3.3
25	3.3	3.6	7.0	3.95	5.1	5.4	3.9	3.35	3.3	3.55	3.4	3.3
26	3.3	3.6	6.4	3.95	4.9	4.8	3.8	3.6	3.3	3.5	3.45	3.25
27	3.35	3.6	6.0	3.95	4.7	4.5	3.75	3.7	3.25	3.45	3.45	3.2
28	3.4	3.55	5.8	3.9	4.65	4.3	3.7	3.65	3.3	3.4	3.65	3.25
29	3.4	.....	5.6	3.85	4.65	4.15	3.75	3.55	3.25	3.4	3.85	3.2
30	3.45	.....	5.4	3.8	4.6	4.15	3.7	3.5	3.25	3.35	3.6	3.2
31	3.45	.....	5.1	.....	4.8	.....	3.65	3.45	.....	3.3	.....	3.1

NOTE.—River frozen part way across January 1 to March 9, inclusive, also December 1–31.

Station rating table for Cedar River at Cedar Rapids, Iowa, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	880	4.20	3,820	5.40	8,190	7.20	15,330
3.10	1,050	4.30	4,150	5.50	8,570	7.40	16,150
3.20	1,230	4.40	4,490	5.60	8,950	7.60	16,970
3.30	1,425	4.50	4,840	5.70	9,340	7.80	17,790
3.40	1,635	4.60	5,190	5.80	9,730	8.00	18,610
3.50	1,855	4.70	5,550	5.90	10,120	8.20	19,450
3.60	2,090	4.80	5,920	6.00	10,510	8.40	20,290
3.70	2,335	4.90	6,290	6.20	11,310	8.60	21,130
3.80	2,595	5.00	6,670	6.40	12,110	8.80	21,970
3.90	2,875	5.10	7,050	6.60	12,910	9.00	22,810
4.00	3,170	5.20	7,430	6.80	13,710	9.20	23,670
4.10	3,490	5.30	7,810	7.00	14,510	9.40	24,530

The above table is applicable only for open-channel conditions It is based on 26 discharge measurements made during 1902–1905. It is well defined between gage heights 3 feet and 7.2 feet.

Estimated monthly discharge of Cedar River at Cedar Rapids, Iowa, for 1905.

[Drainage area, 6,317 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 10-31	22,810	7,050	12,210	1.93	1.58
April	6,290	2,595	3,702	.586	.654
May	18,200	1,855	7,030	1.11	1.28
June	9,730	3,330	6,002	.950	1.06
July	8,190	2,212	4,585	.726	.837
August	2,335	1,425	1,819	.288	.332
September	2,212	1,230	1,479	.234	.261
October	2,212	965	1,453	.230	.265
November	2,875	1,425	1,908	.302	.337

NOTE.—No estimate for ice period.

RED CEDAR RIVER AT JANESVILLE, IOWA.

This station was established April 26, 1905. It is located on the Illinois Central Railroad bridge at Janesville, Iowa, about one-fourth mile below the highway bridge.

The channel is straight for 1,000 feet above and below the station. Both banks are high, clean, and not subject to overflow. The bed of the stream is composed of gravel and is permanent. The current is swift. Two old piers, which have been torn down, may cause some inaccuracy in measurements at very low water, but there are several good sections near by where measurements can be made by wading.

Discharge measurements are made from the upstream side of the two-span highway bridge to which the gage is attached. The initial point for soundings is the inner upstream face of the left abutment.

A standard chain gage, which was read once each day during 1905 by J. E. Davis, is fastened to the upstream side of the left span of the bridge, 150 feet from the left abutment. The length of the chain from the end of the weight to the last copper link is 25.77 feet. The gage is referred to bench marks as follows: (1) A cross on the east end of the northeast coping of the east abutment; elevation above gage datum, 24.30 feet. (2) Center of the gage pulley; elevation above zero of gage, 25.57 feet.

Discharge measurements of Red Cedar River at Janesville, Iowa, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	M. S. Brennan	150	210	2.49	1.14	522
May 24	Hanna and Hoyt	178	419	2.94	2.35	1,230
June 22	F. W. Hanna	219	1,033	3.25	5.50	3,358
July 19	Hanna and Clapp	183	529	3.36	3.00	1,775
September 23	M. S. Brennan	153	199	2.00	1.02	397
October 29	do	155	203	1.91	1.03	388

Daily gage height, in feet, of Red Cedar River at Janesville, Iowa, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.0	2.6	2.3	1.2	1.1	1.0	0.9	2.7
2	.....	1.0	2.5	2.6	1.3	1.1	1.0	.9	3.3
3	.....	1.0	2.2	2.3	1.3	1.1	1.0	.9	3.3
4	.....	1.0	2.0	3.5	1.2	1.1	1.0	.9	3.3
5	.....	1.0	1.8	3.9	1.2	1.1	1.0	1.0	3.3
6	.....	1.0	1.7	3.9	1.2	1.0	.9	1.1	3.2
7	.....	1.0	1.6	3.9	1.1	1.0	.9	1.1	3.1
8	.....	.9	1.5	3.6	1.1	1.0	.9	1.0	2.8
9	.....	.9	1.5	3.9	1.1	1.0	.9	1.1	2.7
10	.....	1.1	1.4	3.4	1.1	1.0	1.0	1.1	2.5
11	.....	2.3	1.8	2.9	1.1	1.0	.9	1.1	2.3
12	.....	4.2	3.1	2.5	1.1	1.0	.9	1.1	2.1
13	.....	2.4	3.9	2.4	1.1	1.0	.9	1.1	1.9
14	.....	2.4	3.7	2.1	1.4	1.0	.9	1.1	1.7
15	.....	3.9	3.9	2.0	1.4	1.0	1.0	1.1	1.7
16	.....	5.6	2.8	2.0	1.3	1.0	.9	1.0	1.7
17	.....	7.6	2.6	1.8	1.2	1.1	1.1	1.0	1.7
18	.....	6.5	3.4	1.6	1.2	1.1	1.2	1.0	1.7
19	.....	4.9	5.3	3.2	1.1	1.2	1.1	1.0	1.7
20	.....	4.0	6.3	2.0	1.1	1.2	1.1	1.0	1.5
21	.....	3.4	6.7	1.6	1.1	1.2	1.2	1.0	1.5
22	.....	2.9	6.2	1.5	1.1	1.1	1.2	1.0	.....
23	.....	2.6	4.7	1.5	1.0	1.1	1.2	.9	.....
24	.....	2.3	3.5	1.4	1.2	1.1	1.2	1.0	.....
25	.....	2.2	2.8	1.3	1.7	1.0	1.2	1.1	.....
26	.....	2.0	2.4	1.3	1.3	1.0	1.1	1.1	.....
27	1.1	1.9	2.1	1.3	1.3	1.0	1.1	1.0	.....
28	1.1	1.8	1.9	1.3	1.3	1.0	1.1	1.2	.....
29	1.1	2.4	1.8	1.3	1.3	1.0	1.0	1.3	.....
30	1.0	2.3	1.8	1.2	1.3	1.0	1.0	1.0	.....
31	.....	2.9	.....	1.2	1.2	.....	.9	.....	.....

NOTE.—River frozen entirely across during December.

Station rating table for Red Cedar River at Janesville, Iowa, from April 26 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	180	1.90	935	3.30	1,880	5.40	3,420
0.60	210	2.00	1,000	3.40	1,950	5.60	3,570
0.70	245	2.10	1,065	3.50	2,020	5.80	3,720
0.80	285	2.20	1,130	3.60	2,090	6.00	3,870
0.90	330	2.30	1,195	3.70	2,160	6.20	4,030
1.00	380	2.40	1,260	3.80	2,230	6.40	4,190
1.10	435	2.50	1,325	3.90	2,300	6.60	4,350
1.20	495	2.60	1,390	4.00	2,370	6.80	4,510
1.30	555	2.70	1,460	4.20	2,520	7.00	4,670
1.40	615	2.80	1,530	4.40	2,670	7.20	4,830
1.50	675	2.90	1,600	4.60	2,820	7.40	4,990
1.60	740	3.00	1,670	4.80	2,970	7.60	5,150
1.70	805	3.10	1,740	5.00	3,120	7.80	5,310
1.80	870	3.20	1,810	5.20	3,270	8.00	5,470

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is fairly well defined between gage heights 1 foot and 3 feet. The table has been extended beyond these limits. Below 1 foot and above 4 feet the table is very uncertain.

Estimated monthly discharge of Red Cedar River at Janesville, Iowa, for 1905.

[Drainage area, 1,840 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	5,150	330	1,434	0.779	0.898
June	4,430	615	1,694	.921	1.03
July	2,300	495	1,199	.652	.752
August	805	380	503	.273	.315
September	495	380	410	.223	.249
October	495	330	397	.216	.249
November	555	330	402	.218	.243

NOTE.—No estimate for ice period.

DES MOINES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Des Moines River rises in the southern part of Minnesota, flows to the south and southeast, and enters the Mississippi near Keokuk, Iowa. Its principal tributary is Raccoon River, which joins it at the city of Des Moines. The total drainage area of the Des Moines is 14,720 square miles. Above the mouth of the Raccoon its drainage area is 6,462 miles, while that of the Raccoon at its confluence with the Des Moines is 3,677 square miles.

The Des Moines is the largest stream in the State of Iowa and affords numerous opportunities for the development of water power. It is the natural recipient of the sewage of many towns.

DES MOINES RIVER AT FORT DODGE, IOWA.

This station was established April 22, 1905. It is located at the "Swede Town" bridge, the only highway bridge in Fort Dodge.

The channel is straight for 1,000 feet above and below the station. Both banks are fairly high, clean, and do not overflow. The bed of the stream is composed of sand, gravel, and mud, is free from vegetation, and is permanent. The current is fairly swift.

Discharge measurements are made from the downstream side of the two-span bridge to which the gage is fastened. The initial point for soundings is the downstream inner face of the right abutment.

A standard chain gage, which was read during 1905 by Andrew J. Moe, is attached to the floor of the downstream footway of the bridge. The length of the chain from the end of the weight to the last copper link is 35.72 feet. The gage is referred to bench marks as follows: (1) A painted line on the west abutment; elevation, 9.11 feet. (2) Floor of the bridge at the initial point for soundings; elevation, 35.54 feet. (3) Center of pulley of gage; elevation, 35.54 feet. All elevations are above datum of gage.

Discharge measurements of Des Moines River at Fort Dodge, Iowa, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 22	M. S. Brennan	266	948	2.00	4.10	1,895
May 24	Hoyt and Hanna	276	1,462	3.00	5.81	4,388
June 29	F. W. Hanna	250	727	1.59	3.40	1,147
July 19	Hanna and Clapp	276	1,277	2.89	5.36	3,692
August 7	F. W. Hanna	260	830	1.86	3.80	1,545
September 23	M. S. Brennan	255	754	1.64	3.48	1,238

Daily gage height, in feet, of Des Moines River at Fort Dodge, Iowa, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.1	6.6	3.95	4.05	3.3	3.9	3.05	3.7
2	.....	3.0	6.7	4.3	4.35	3.1	3.7	3.0	4.05
3	.....	2.9	6.4	4.55	4.1	2.9	3.5	2.95	4.0
4	.....	2.9	6.2	4.55	4.0	2.85	3.4	2.95	3.9
5	.....	2.8	5.9	4.7	3.9	2.7	3.3	3.1	3.9
6	.....	2.9	5.8	4.9	3.8	2.7	3.25	3.4	3.9
7	.....	2.8	5.5	5.0	3.8	2.6	3.2	3.9	3.9
8	.....	2.9	5.2	5.1	3.75	2.55	3.05	4.15	3.95
9	.....	2.9	4.9	5.45	3.7	2.55	3.0	4.25	3.95
10	.....	3.4	4.65	5.75	3.6	2.5	3.05	4.3	4.0
11	.....	3.8	4.55	6.0	3.45	2.45	2.95	4.4	3.9
12	.....	4.9	4.5	6.2	3.3	2.5	2.85	4.4	3.85
13	.....	4.9	4.35	6.2	3.2	2.4	2.85	4.35	3.95
14	.....	5.7	4.1	6.1	3.2	2.4	2.9	4.3	3.9
15	.....	6.0	4.0	6.0	3.15	2.4	3.15	4.25	4.8
16	.....	6.6	3.8	5.8	3.1	2.4	3.1	4.1	.....
17	.....	7.0	3.6	5.65	3.05	2.5	3.15	4.0	.....
18	.....	7.0	3.5	5.55	3.05	2.4	3.2	3.9	.....
19	.....	6.9	3.6	5.45	3.0	2.5	3.3	3.8	.....
20	.....	6.8	4.0	5.3	[a]3.0	2.6	3.4	3.7	.....
21	.....	6.8	4.2	5.2	3.0	2.8	3.5	3.6	.....
22	.....	6.6	4.2	5.1	2.95	3.05	3.6	3.5	.....
23	4.0	6.2	3.9	5.0	2.9	3.5	3.6	3.45	.....
24	3.8	5.9	3.8	4.85	3.75	4.05	3.6	3.7	.....
25	3.5	5.7	3.55	4.75	3.5	4.45	3.6	3.85	.....
26	3.5	5.45	3.5	4.7	3.5	4.9	3.6	4.0	.....
27	3.5	5.3	3.35	4.6	3.35	5.0	3.5	4.15	.....
28	3.4	5.2	3.3	4.5	3.3	4.85	3.35	4.35	.....
29	3.3	6.2	3.5	4.4	3.3	4.6	3.3	4.45	.....
30	3.2	6.3	3.7	4.3	3.4	4.2	[a]3.2	3.85	.....
31	.....	6.3	.....	4.25	3.5	.....	3.1	.....	.....

[a] Gage heights interpolated.

Station rating table for Des Moines River at Fort Dodge, Iowa, from April 23 to December 31, 1905.

Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	430	3.50	1,255	4.60	2,545	5.70	4,225
2.50	490	3.60	1,350	4.70	2,690	5.80	4,380
2.60	550	3.70	1,450	4.80	2,835	5.90	4,535
2.70	615	3.80	1,555	4.90	2,985	6.00	4,690
2.80	685	3.90	1,665	5.00	3,140	6.20	5,010
2.90	755	4.00	1,780	5.10	3,295	6.40	5,350
3.00	830	4.10	1,895	5.20	3,450	6.60	5,710
3.10	905	4.20	2,015	5.30	3,605	6.80	6,080
3.20	985	4.30	2,140	5.40	3,760	7.00	6,460
3.30	1,070	4.40	2,270	5.50	3,915	7.20	6,840
3.40	1,160	4.50	2,405	5.60	4,070	7.40	7,220

The above table is applicable only for open channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 3.4 feet and 5.8 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Des Moines River at Fort Dodge, Iowa, for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
April 23-30	1,780	985	1,289
May	6,460	685	3,428
June	5,890	1,070	2,553
July	5,010	1,722	3,321
August	2,205	755	1,237
September	3,140	430	1,066
October	1,665	720	1,081
November	2,338	792	1,642
December 1-15	2,835	1,450	1,763

DES MOINES RIVER AT DES MOINES, IOWA.

This station was established May 24, 1905. It is located at the Interurban Bridge at Des Moines, Iowa, near the suburb of Highland Park.

The channel is straight for 500 feet above and below the station. Both banks are fairly high, wooded, and overflow during floods. The bed of the stream is composed of sand and silt and is slightly shifting. There is but one channel at all stages, broken by the piers of the bridge, all the water passing between the abutments. The current is moderately swift.

Discharge measurements are made from the downstream side of the three-span bridge, with trestle at both ends, to which the gage is attached. The initial point for soundings is the inner face of the left trestle abutment.

A standard chain gage, which was read during 1905 by Frank Peterson, is fastened to the binding tie of the downstream side of the bridge. The length of the chain from the end of the weight to the marker is 30.30 feet. August 8 a new chain gage was installed. It was located in the same place as the old gage. The chain length was increased to 30.70 feet, the gage datum remaining the same. The gage is referred to bench marks as follows: (1) Top surface of south side of tubular pier at left end of bridge; elevation above gage datum, 24.44 feet. (2) The rail base opposite the gage pulley; elevation above gage datum, 29.74 feet.

Discharge measurements of Des Moines River at Des Moines, Iowa, in 1905

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 26	F. W. Hanna	278	2,275	2.48	8.50	5,653
June 29	do	262	1,905	2.22	7.40	4,227
July 20	Hanna and Clapp	283	2,238	2.32	8.30	5,201
August 8	F. W. Hanna	204	1,704	1.20	6.50	2,048
September 22	M. S. Brennan	279	1,393	.76	5.57	1,064

Daily gage height, in feet, of Des Moines River at Des Moines, Iowa, for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		9.6	7.2	6.7	6.0	6.7	6.0	7.7
2		10.15	7.4	6.5	5.95	6.7	5.9	7.7
3		9.85	7.45	7.25	5.95	6.25	5.9	7.2
4		9.75	7.3	7.1	6.0	6.2	5.9	6.9
5		9.45	7.4	6.75	5.9	6.0	6.0	7.0
6		9.15	7.25	6.6	5.7	6.0	6.1	7.3
7		9.05	7.3	6.5	5.6	5.95	6.0	7.5
8		8.8	7.9	6.4	5.6	5.8	6.4	8.3
9		8.35	7.95	6.4	5.5	5.7	6.7	8.7
10		9.5	7.7	6.3	5.5	5.7	6.8	8.5
11		8.25	7.9	6.15	5.4	5.7	6.8	8.3
12		7.5	8.0	6.15	5.3	5.65	6.9	8.1
13		7.3	8.1	6.0	5.3	5.65	7.0	8.1
14		7.2	9.5	5.95	5.2	5.7	7.0	8.0
15		6.85	8.9	5.95	5.2	5.9	6.9	7.7
16		6.7	8.95	5.9	5.2	6.0	6.9	.....
17		6.7	8.7	6.1	5.3	6.4	6.8	.....
18		6.5	8.9	6.1	5.4	6.4	6.75	.....
19		6.4	8.7	6.0	6.0	6.4	6.7	.....
20		6.3	8.1	5.9	6.0	6.35	6.5	.....
21		6.4	7.9	5.9	5.8	6.4	6.4	.....
22		6.6	7.65	6.0	5.5	6.5	6.35	.....
23		6.7	7.3	5.95	5.7	6.4	6.4	.....
24		6.4	7.25	6.0	5.95	6.4	6.7	.....
25		6.3	7.1	6.2	6.0	6.3	6.7	.....
26		6.25	7.15	6.15	6.2	6.4	6.8	.....
27	8.15	6.15	7.1	6.1	6.25	6.2	6.9	.....
28	8.15	6.0	7.05	6.05	6.4	6.2	6.9	.....
29	8.1	9.6	6.9	6.1	7.1	6.4	7.0	.....
30	8.6	7.05	6.9	6.05	6.9	6.2	7.4	.....
31	9.6	.....	6.85	6.0	.....	5.9	.....	.....

NOTE.—Ice conditions during December.

Station rating table for Des Moines River at Des Moines, Iowa, from May 27 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.00	510	6.20	1,810	7.40	3,710	8.50	5,650
5.10	595	6.30	1,950	7.50	3,880	8.60	5,830
5.20	685	6.40	2,095	7.60	4,050	8.70	6,020
5.30	780	6.50	2,245	7.70	4,220	8.80	6,210
5.40	880	6.60	2,400	7.80	4,390	8.90	6,400
5.50	980	6.70	2,555	7.90	4,570	9.00	6,590
5.60	1,085	6.80	2,715	8.00	4,750	9.20	6,970
5.70	1,195	6.90	2,875	8.10	4,930	9.40	7,350
5.80	1,310	7.00	3,040	8.20	5,110	9.60	7,730
5.90	1,430	7.10	3,205	8.30	5,290	9.80	8,110
6.00	1,555	7.20	3,370	8.40	5,470	10.00	8,500
6.10	1,680	7.30	3,540				

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is not well defined. The channel here is shifting and later measurements may plot on a different curve. This table is not very satisfactory, as the three lower measurements are not consistent.

Estimated monthly discharge of Des Moines River at Des Moines, Iowa, for 1905.

[Drainage area, 6,462 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May 27-31	7,730	4,930	5,706	0.883	0.164
June	8,800	1,555	4,340	.672	.750
July	7,540	2,795	4,313	.667	.769
August	3,455	1,430	1,885	.292	.337
September	3,205	685	1,350	.209	.233
October	2,555	1,140	1,761	.273	.315
November 1-29	3,040	1,430	2,486	.385	.415

NOTE.—No estimate for ice period.

DES MOINES RIVER AT KEOSAUQUA, IOWA.

This station was established May 30, 1903. It is located on the county bridge one-fourth mile above the old dam site and Government locks.

The channel is straight for 1,000 feet above and below the station and has a width between abutments of 614 feet, broken by three bridge piers. The right bank is high and rocky and is not subject to overflow; the low alluvial bank on the left side is subject to overflow at extremely high stages. The bed of the stream is regular in shape and is composed of sand and gravel on the left and of rock on the right side. A slight shifting of the sand occurs at flood stages. The current is swift. The stream is divided into four channels by the bridge piers.

Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is the edge of the west abutment and is marked zero on the hand rail at the left bank.

The standard chain gage, which was read during 1905 by Oscar McCrary, is so located that the zero of its scale is 1 foot to the left of the sixth strut from the right end of the second span from the right end of the bridge. The length of the chain from the end of the weight to the marker is 36.80 feet. The gage is referred to bench marks as follows: (1) A cross on the bridge-seat stone at the northeast corner of the right abutment of the bridge; elevation above gage datum, 30.11 feet; above sea level, as determined from the Iowa Geological Survey bench mark in front of the Keosauqua railroad station, 617.06 feet. (2) A spike driven into a blazed place near the base of an oak tree on the north side of the road about 100 feet from the bridge; elevation above sea level, 619.83 feet; above gage datum, 32.88 feet. (3) Notch chiseled into a rock cliff on the right bank of the river south of the road leading across the highway bridge at a distance of 120 feet from the east end of the bridge; elevation above gage datum, 36.25 feet. (4) On the top of the guard rail, 2 feet east of the zero of the gage; elevation above gage datum, 36.80 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 29; 130, pp 65-66.
Discharge: 99, p 29; 130, p 36.
Discharge, monthly: 99, p 31; 130, p 37.
Gage heights: 99, p 30; 130, p 36.
Rating table: 99, p 30; 130, p 37.

Discharge measurements of Des Moines River at Keosauqua, Iowa, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 27	M. S. Brennan	590	3,494	2.79	4.91	9,760
June 28	F. W. Hanna	580	2,034	1.82	2.20	3,695
July 21	S. K. Clapp	588	4,500	3.49	6.42	15,710
September 21	M. S. Brennan	588	3,259	2.95	4.30	9,618
October 26	do	577	2,415	2.10	2.60	5,076

Daily gage height, in feet, of Des Moines River at Keosauqua, Iowa, for 1905.

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			9.4	4.05	4.0	4.25	9.4	2.6	1.88	2.15	2.15	2.75
2			8.2	3.7	3.4	4.6	9.4	[a] 2.9	1.72	2.2	2.1	2.5
3			8.3	3.7	3.05	5.1	7.4	[a] 3.2	1.68	2.18	2.02	1.9
4		0.8	7.2	3.7	2.9	5.5	7.3	3.5	1.62	2.05	1.98	1.85
5			6.8	3.5	2.7	5.25	5.1	3.2	1.55	1.95	1.98	1.75
6			6.6	3.35	2.45	4.9	4.35	2.85	1.48	1.8	3.05	1.38
7	0.8		6.0	3.5	2.35	4.6	4.35	2.6	1.42	1.65	4.8	1.52
8			5.8	3.7	2.25	4.2	4.0	2.3	1.4	1.55	5.05	1.8
9			5.5	3.75	2.2	4.0	4.3	2.1	1.4	1.48	4.45	1.95
10			5.1	3.8	2.72	22.8	4.6	1.98	1.38	1.55	3.85	2.1
11		.8	4.6	3.6	4.75	14.4	4.5	1.88	1.32	1.4	3.2	2.35
12			4.15	3.35	7.0	10.6	4.7	1.8	1.3	1.35	2.95	2.1
13			3.9	3.2	7.6	8.05	4.4	1.72	1.22	1.4	2.9	2.4
14	.8		3.6	2.9	8.4	5.6	3.9	1.7	1.2	1.48	2.88	2.4
15			3.2	2.75	8.6	4.6	4.5	6.3	1.4	1.78	2.85	2.2
16			2.9	2.55	8.4	3.95	6.2	4.9	1.88	1.62	2.78	2.08
17			2.8	2.45	8.5	3.6	6.5	3.2	2.4	3.75	2.7	1.95
18		.9	2.95	2.35	8.0	3.35	4.6	3.5	2.75	7.35	2.62	2.05
19			4.0	2.22	7.6	3.2	4.1	3.65	3.65	7.6	2.55	2.0
20			5.4	2.45	7.6	3.65	6.1	2.68	4.6	6.6	2.5	2.0
21	.7		5.7	6.2	7.7	3.2	6.4	2.25	4.35	5.5	2.4	1.95
22			5.8	5.65	7.3	3.05	5.0	2.5	3.75	4.5	2.3	1.8
23			5.9	4.1	6.7	2.9	4.35	4.1	3.1	3.8	2.15	1.78
24			6.4	4.7	6.1	2.75	3.65	6.0	2.38	3.0	2.3	1.65
25		4.2	6.6	4.1	5.6	2.65	3.3	8.2	1.9	2.7	3.45	1.55
26		4.4	5.2	4.75	5.2	2.45	3.05	5.0	1.68	2.62	3.2	1.68
27		4.4	4.9	6.3	4.75	2.28	2.9	3.35	1.62	2.52	3.3	1.6
28	.8	4.7	4.8	5.9	4.35	2.18	2.8	2.7	1.62	2.42	3.3	1.75
29			5.2	5.7	4.15	2.52	2.8	2.42	1.75	2.32	3.2	1.8
30			4.8	5.05	4.25	4.85	2.8	2.4	2.0	2.28	3.1	1.68
31			4.35	.....	4.4	.....	2.72	2.2	.....	2.18	.....	1.6

[a] Gage heights interpolated.

NOTE.—River frozen over January 1 to February 25. Water rose flush with surface of ice at each reading. Thickness of ice, 0.4 foot January 1; 1 foot January 21, and 1.3 feet February 4. There were slight ice conditions during December, but not sufficient to modify the flow appreciably.

Station rating table for Des Moines River at Keosauqua, Iowa, from January 1 to December 31 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	300	2.00	3,305	3.50	7,200	5.80	13,890
0.60	450	2.10	3,545	3.60	7,470	6.00	14,550
0.70	610	2.20	3,790	3.70	7,740	6.20	15,210
0.80	780	2.30	4,035	3.80	8,010	6.40	15,870
0.90	960	2.40	4,285	3.90	8,280	6.60	16,530
1.00	1,150	2.50	4,540	4.00	8,550	6.80	17,210
1.10	1,350	2.60	4,795	4.20	9,090	7.00	17,890
1.20	1,550	2.70	5,055	4.40	9,650	7.50	19,590
1.30	1,755	2.80	5,320	4.60	10,220	8.00	21,290
1.40	1,965	2.90	5,585	4.80	10,800	8.50	23,010
1.50	2,180	3.00	5,850	5.00	11,400	9.00	24,790
1.60	2,395	3.10	6,120	5.20	12,000	9.50	26,590
1.70	2,615	3.20	6,390	5.40	12,620	10.00	28,390
1.80	2,840	3.30	6,660	5.60	13,250	11.00	32,090
1.90	3,070	3.40	6,930				

The above table is applicable only for open-channel conditions. It is based on 19 discharge measurements made during 1903–1905. It is fairly well defined between gage heights 0.8 foot and 6.4 feet. The table has been extended beyond these limits. Above 11 feet the discharge is estimated, being based on 1 measurement at 15.7 feet.

Estimated monthly discharge of Des Moines River at Keosauqua, Iowa, for 1905.

[Drainage area, 14,290 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March	26,230	5,320	12,750	0.892	1.03
April	15,540	3,839	8,398	.588	.656
May	23,360	3,790	12,840	.898	1.04
June	75,750	3,741	12,790	.895	.999
July	26,230	5,108	11,160	.781	.900
August	21,970	2,615	6,609	.462	.533
September	10,220	1,550	3,542	.248	.277
October	19,930	1,860	5,607	.392	.452
November	11,550	3,258	5,724	.401	.447
December	5,188	1,923	3,165	.221	.255

See gage-height table footnote.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Des Moines River basin in 1904.

Miscellaneous discharge measurements in Des Moines River basin in 1904.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Square feet.*	*Feet per second.*	*Second-feet.*
May 28	Des Moines	Des Moines	384	2,014	2.41	4,852
June 6	do	Fort Dodge	307	1,142	2.39	2,729
Nov. 13	do	Des Moines	168	176	.42	74
Nov. 14	Raccoon	do	115	146	1.36	199

ILLINOIS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Illinois River, the most extensive of all the tributaries of the Upper Mississippi, enters the main stream from the east about 24 miles above the mouth of the Missouri. Its drainage area of 29,013 square miles is distributed among three States; 24,726 square miles are in Illinois, and extend in a broad band 250 miles long and averaging 100 miles in width directly across the center of the State in a northeast-southwest direction. From the upper extremity of this band are two projections—one north into Wisconsin, comprising 1,080 square miles in that State; the other east into Indiana, including 3,207 square miles of its northern portion.

The eastern projection is the basin of Kankakee River, while the northern one forms the basins of Fox and Desplaines rivers. The union of the drainages of these projections may be considered the origin of the Illinois. The name Illinois is applied to the river from the junction of the Kankakee and Desplaines.

The region drained by the Illinois is level and undulating and includes some of the finest land in the United States. Many large and prosperous cities are situated within it, and it is covered with a network of railroads.

The drainage into the Illinois is quite evenly distributed along its course. The more important tributaries are Fox and Spoon rivers from the west, and the Kankakee, Vermilion, and Sangamon from the east.

ILLINOIS RIVER NEAR PEORIA, ILL.

This station was established March 10, 1903. It is located on the Peoria and Pekin Union Railroad bridge over the Illinois River, 1½ miles southwest of Peoria. It can be reached by street cars.

The channel is straight for 3,000 feet above and 2,000 feet below the station, and has a width of about 1,000 feet, broken by six piers. A railroad embankment runs along the right bank, which is high. The left bank is low and liable to overflow. The bed of the stream is composed of gravel and silt.. The section is deep and the flow sluggish.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the face of the abutment on the right bank.

The gage, which was read during 1905 by Peter A. Blumb, is a plain staff fastened to the central pier of the bridge. The bench mark is the southwest corner of the top stone of the west abutment of the bridge; elevation, 125.722 feet below the Chicago datum. The gage at this point has for its zero a point 153.814 feet below the Chicago city datum. The gage reads up from this point, and in order to obtain the height of the river, referred to the Chicago datum, it is necessary to subtract the gage reading from 153.814 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 21, iv, p 176; WS 83, p 172; 58, pp 199-200; 128, p 39.
Discharge: Ann 21, iv, p 176; WS 98, p 200; 128, p 39.
Discharge, monthly: WS 98, p 202.
Gage heights: WS 98, pp 200-201; 128, p 40.
Rating table: WS 98, p 201.

Discharge measurements of Illinois River near Peoria, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 5	M. S. Brennan	950	12,190	1.60	13.70	19,450
May 11	S. K. Clapp	953	11,570	1.85	13.00	21,450
June 28	M. S. Brennan	941	10,690	1.44	12.25	15,410
July 31	do	893	7,143	1.15	8.50	8,242
September 31	do	909	7,896	1.16	9.28	9,137
October 30	do	890	7,059	1.11	8.26	7,835

Daily gage height, in feet, of Illinois River near Peoria, Ill., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.75	9.33	12.5	14.0	13.9	14.7	11.6	8.46	8.08	8.42	8.17	7.92
2	8.75	9.33	13.0	14.0	13.9	14.6	11.55	8.46	8.17	8.33	8.17	7.92
3	8.75	9.33	13.5	14.0	13.8	14.4	11.35	8.38	8.25	8.25	8.08	8.08
4	8.79	9.33	14.2	13.8	13.7	14.2	11.0	8.42	8.79	8.38	8.08	8.08
5	8.88	9.33	14.5	13.8	13.6	13.9	10.95	8.42	9.12	8.33	8.0	8.08
6	8.92	9.33	14.8	13.7	13.6	14.4	10.4	8.42	9.38	8.12	8.0	8.08
7	8.92	9.33	14.9	13.6	13.4	14.0	10.85	8.42	9.6	7.96	8.08	8.08
8	9.08	9.33	15.0	13.5	13.2	13.9	10.75	8.29	9.8	7.88	8.08	8.2
9	9.08	9.42	15.0	13.3	13.1	13.6	10.75	8.25	9.85	7.8	8.17	8.33
10	9.0	9.5	14.9	13.1	13.0	14.0	10.65	8.17	9.85	7.92	8.17	8.33
11	9.17	9.5	14.7	13.2	12.8	14.0	10.6	8.04	9.85	7.84	8.05	8.33
12	9.17	.....	14.5	13.1	13.0	14.0	10.45	8.0	9.8	7.75	8.0	8.25
13	9.17	.....	14.3	12.9	13.2	14.0	10.4	8.0	9.85	7.62	8.12	8.33
14	9.17	.....	14.0	13.8	14.0	14.1	10.35	8.17	9.6	7.58	8.05	8.33
15	9.17	.....	13.9	13.7	15.1	14.1	10.2	8.29	9.6	7.42	8.0	8.3
16	9.17	.....	13.6	13.5	16.2	14.0	10.1	8.33	9.55	7.55	8.0	8.25
17	9.17	.....	13.4	13.3	16.8	13.8	9.9	8.25	9.6	7.67	8.42	8.17
18	9.17	9.5	13.3	13.1	17.2	13.6	9.9	8.17	9.42	7.96	8.42	8.08
19	9.17	9.42	13.3	13.1	17.4	13.7	9.75	8.33	9.21	8.0	7.95	8.08
20	9.21	9.42	13.4	12.8	17.4	13.6	9.65	8.33	9.25	7.96	7.8	8.17
21	9.29	9.6	13.5	13.0	17.0	13.5	9.5	8.42	9.25	7.92	7.67	8.33
22	9.33	9.7	13.5	13.2	16.3	13.4	9.29	8.42	9.25	7.8	7.67	8.33
23	9.33	9.75	13.5	13.3	16.5	13.2	9.21	8.42	9.29	7.92	7.45	8.33
24	9.33	9.9	13.6	13.7	16.2	13.0	9.04	8.42	9.21	8.17	7.3	8.33
25	9.42	10.35	13.5	13.0	15.9	12.8	8.92	8.17	9.04	8.25	7.33	8.33
26	9.38	10.95	13.7	13.3	15.7	12.7	8.83	8.29	8.83	8.17	7.3	8.2
27	9.25	11.45	13.8	13.5	15.5	12.5	8.71	8.17	8.75	8.2	7.5	8.17
28	9.25	11.9	13.8	13.7	16.2	12.3	8.62	8.17	8.67	8.3	7.67	8.08
29	9.25	.....	14.0	13.7	15.1	12.1	8.58	8.08	8.58	8.25	7.55	8.33
30	9.25	.....	14.0	13.8	15.0	11.9	8.42	8.12	8.5	8.2	7.8	8.67
31	9.33	.....	14.0	.....	14.9	.....	8.5	8.17	.....	8.17	.....	8.75

NOTE.—Ice conditions January 1 to March 31. Thickness of ice, 0.5 to 1 foot.

Station rating table for Illinois River near Peoria, Ill., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.40	6,990	9.90	10,210	12.30	15,470	14.70	22,930
7.50	7,080	10.00	10,390	12.40	15,730	14.80	23,310
7.60	7,175	10.10	10,570	12.50	16,000	14.90	23,700
7.70	7,270	10.20	10,760	12.60	16,270	15.00	24,090
7.80	7,370	10.30	10,950	12.70	16,540	15.10	24,510
7.90	7,470	10.40	11,140	12.80	16,820	15.20	24,940
8.00	7,575	10.50	11,340	12.90	17,110	15.30	25,370
8.10	7,680	10.60	11,540	13.00	17,400	15.40	25,810
8.20	7,790	10.70	11,750	13.10	17,690	15.50	26,260
8.30	7,900	10.80	11,960	13.20	17,990	15.60	26,710
8.40	8,020	10.90	12,170	13.30	18,290	15.70	27,170
8.50	8,140	11.00	12,390	13.40	18,590	15.80	27,640
8.60	8,265	11.10	12,610	13.50	18,900	15.90	28,120
8.70	8,390	11.20	12,830	13.60	19,210	16.00	28,600
8.80	8,520	11.30	13,050	13.70	19,520	16.20	29,560
8.90	8,650	11.40	13,280	13.80	19,840	16.40	30,530
9.00	8,790	11.50	13,510	13.90	20,160	16.60	31,510
9.10	8,930	11.60	13,740	14.00	20,480	16.80	32,500
9.20	9,080	11.70	13,980	14.10	20,810	17.00	33,500
9.30	9,230	11.80	14,220	14.20	21,150	17.20	34,500
9.40	9,390	11.90	14,460	14.30	21,490	17.40	35,500
9.50	9,550	12.00	14,700	14.40	21,840	17.60	36,500
9.60	9,710	12.10	14,950	14.50	22,200	17.80	37,500
9.70	9,870	12.20	15,210	14.60	22,560	18.00	38,500
9.80	10,040						

The above table is applicable only for open-channel conditions. It is based on 27 discharge measurements made during 1903–1905. It is fairly well defined between gage heights 8.3 feet and 16 feet.

Estimated monthly discharge of Illinois River near Peoria, Ill., for 1904.

[Drainage area, 13,250 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 21-31	57,650	37,650	51,330	3.87	1.58
April	54,950	26,440	39,000	2.94	3.28
May	28,410	13,910	19,310	1.46	1.68
June	13,910	7,713	11,000	.830	.926
July	8,572	7,118	7,789	.588	.678
August	8,092	7,008	7,577	.572	.660
September	9,614	6,860	7,531	.568	.634
October	9,822	7,491	8,508	.642	.740
November	7,450	7,156	7,333	.553	.617
December 1-12	7,400	7,080	7,186	.542	.242
1905.					
April	20,480	16,820	18,760	1.42	1.58
May	35,500	16,820	24,580	1.86	2.14
June	22,930	14,460	19,320	1.46	1.63
July	13,740	8,044	10,490	.792	.913
August	8,092	7,575	7,875	.594	.685
September	10,125	7,659	9,134	.689	.769
October	8,044	7,008	7,587	.573	.661
November	8,044	6,900	7,473	.564	.629
December	8,355	7,491	7,851	.593	.684

NOTE.—No estimate for ice period.

DESPLAINES RIVER NEAR CHANNAHON, ILL.

This station was established October 23, 1902. It is located just above the mouth of Jackson Creek, 2½ miles southwest of Millsdale and 2 miles east of Channahon, Ill.

The channel is straight for about 3,000 feet both above and below the station, and has a width of 360 feet and a maximum depth of 16 feet at ordinary stages. Both banks are low and liable to overflow, but a few feet from the top of the banks are high ridges which never overflow. The bed of the stream is composed of gravel. The current is moderately swift.

Discharge measurements at this station were discontinued April 14, 1904.

The gage, which was read during 1905 by Ruth Alexander, is a vertical staff. The bench mark is the top of the red-oak hub driven in the bluff between Jackson Creek and the south bank of Desplaines River, about 300 feet west of the west line of sec. 15, T. 37 N., R. 9 E., third principal meridian; and is on the farm owned by George Alexander; its elevation is 64.26 feet below the Chicago datum. The gage is set with its zero at the same elevation as the zero of the Chicago datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 83, pp 174, 175; 98, pp 212, 213-214; 128, pp 40-41.
Discharge: 98, pp 212, 214; 128, p 41.
Discharge, monthly: 128, p 43.
Gage heights: 98, pp 213, 214-215; 128, p 42.
Rating table: 128, p 43.

Daily gage height,[a] in feet, of Desplaines River near Channahon, Ill., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	82.74	80.8	78.5	82.52	82.92	83.72	83.5	82.95	83.15	83.42	83.75	83.15
2	82.85	80.3	79.7	82.58	82.95	83.7	83.55	83.1	82.05	83.32	83.9	83.15
3	83.18	79.8	.....	82.25	83.08	83.65	83.45	83.15	82.9	83.42	83.85	83.35
4	83.05	80.0	82.2	82.82	83.15	82.4	83.4	83.22	82.4	83.3	83.88	83.2
5	82.89	80.1	82.6	82.8	83.3	82.52	83.3	83.4	82.5	83.35	83.8	83.35
6	82.88	80.2	82.5	82.85	83.32	82.98	83.45	83.5	82.52	83.3	83.1	83.28
7	83.1	.....	82.68	82.7	83.58	83.1	.....	83.3	.....	83.3	83.1	83.4
8	83.35	82.1	82.72	82.92	83.48	83.3	83.42	83.3	82.7	83.3	83.2	83.28
9	82.92	.....	82.7	82.98	83.6	83.45	83.82	83.0	82.95	83.3	83.68	83.22
10	82.92	79.3	82.85	82.98	83.4	82.65	83.85	83.3	83.08	83.2	83.78	83.4
11	82.78	.....	82.75	83.48	82.3	81.8	83.88	83.35	83.02	83.3	83.88	83.35
12	82.48	.....	82.76	84.85	78.6	82.58	83.85	83.3	83.1	83.4	83.9	83.32
13	82.48	.....	82.88	84.2	78.5	82.88	83.9	83.2	83.05	83.42	83.85	83.38
14	82.2	.....	82.7	83.65	79.2	83.05	83.3	83.2	83.2	83.35	83.85	83.35
15	81.2	.....	82.95	83.6	79.5	82.12	83.8	83.25	83.2	83.42	84.08	83.45
16	80.5	79.8	82.88	83.6	80.0	83.18	83.3	83.25	83.15	83.3	84.38	83.38
17	80.8	.....	82.6	83.62	80.4	83.25	83.38	83.35	83.15	83.5	84.35	83.38
18	81.15	.....	82.38	83.6	81.3	83.12	83.55	83.25	83.15	.....	84.35	83.28
19	81.6	79.75	82.05	83.55	82.18	83.1	83.4	83.12	83.2	83.25	83.8	83.4
20	81.95	.....	82.08	83.6	82.5	83.18	83.25	83.22	83.15	83.15	84.35	.....
21	82.5	.....	82.18	81.6	83.0	83.25	83.55	83.18	83.2	83.05	84.58	83.25
22	82.68	.....	82.12	82.4	82.92	83.25	83.50	83.12	83.3	82.98	84.6	83.6
23	82.75	79.9	82.02	82.65	83.32	83.22	83.48	82.95	83.2	83.22	84.6	83.6
24	82.85	.....	81.75	82.62	83.5	.....	83.65	82.98	83.22	82.88	84.4	83.6
25	81.45	.....	81.95	82.78	83.6	83.5	83.55	83.12	83.2	82.88	84.4	83.42
26	80.6	.....	82.0	82.8	83.6	83.28	83.3	83.2	83.32	83.05	84.1	83.5
27	80.4	80.2	82.05	82.55	83.72	83.35	83.35	83.18	83.1	83.3	83.5	83.5
28	80.4	.....	82.28	82.75	83.75	83.58	83.25	83.18	83.25	83.55	83.1	83.35
29	81.15	.....	82.28	82.82	83.68	83.78	83.0	83.1	83.38	83.08	83.4	83.5
30	81.05	.....	82.32	83.0	83.3	83.52	83.08	83.15	83.35	83.18	83.25	83.52
31	81.05	.....	82.5	.....	83.62	.....	82.88	83.15	.....	83.8	.....	83.48

[a] All gage heights of this station are negative, being below Chicago datum.

NOTE.—River frozen half over February 7-28. Gage heights are to water surface in a hole in the ice.

KANKAKEE RIVER AT DAVIS, IND.

This station was established July 13, 1905. It is located at the railroad bridge at Davis, 8 miles west of Hamlet, Ind.

The channel is straight for about 500 feet above and below the station. The right bank consists of grass and farm lands and the left is low and wooded; both banks are subject to overflow during high stages. The bed of the stream is sandy and slightly shifting. All the water passes to the left of the right abutment of the bridge. A portion of the flood water passes through another trestle about 500 feet to the left of the main channel. The velocity is medium at ordinary stages. The section is well adapted for measurements.

Discharge measurements are made from the railway bridge, which is supported by several trestle bents. The initial point for soundings is the inner face of the left pile bent of the structure.

A vertical staff gage, which was read during 1905 by M. H. Fancher, is fastened to the upstream side of one of the pile bents of the bridge. It is referred to bench marks as follows: (1) The rail base at sounding point No. 6; elevation, 16.67 feet above zero of gage. (2) Top of the 12-inch cap directly over the gage; elevation above gage datum, 13.71 feet. (3) Horizontal line of five nails in a telegraph pole about 7 feet north of point 150 feet from initial point for soundings; elevation above datum of gage, 11.95 feet.

Discharge measurements of Kankakee River at Davis, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 22	M. S. Brennan	72	241	0.88	4.55	213
October 3	do	74	238	1.33	4.70	317

Daily gage height, in feet, of Kankakee River at Davis, Ind., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.9	4.7	4.6	4.8	5.8	17	6.6	4.7	5.7	4.6	5.0	
2		4.9	6.4	4.6	4.9	5.7	18	5.8	4.6	5.6	4.8	5.0	
3		4.9	7.3	4.6	4.9	5.5	19	5.4	4.6	5.4	4.9	5.0	
4		4.8	7.8	4.6	4.8		20	5.2	4.8	5.3	5.0	5.0	
5		4.6	7.9	4.6	4.9		21	5.0	4.7	5.2	5.0	5.0	
6		5.5	7.8	4.6	4.9		22	4.9	4.9	5.1	5.0	5.0	
7		5.2	7.2	4.6	5.5		23	4.8	4.6	5.0	5.0	4.9	
8		4.9	6.5	4.6	5.5		24	4.7	4.6	4.9	4.9	4.9	
9		4.6	6.0	4.6	5.4		25	4.7	4.9	4.9	4.9	5.0	
10		4.6	5.9	4.7	5.3		26	4.7	5.0	4.8	4.8	5.0	
11		4.6	5.7	4.7	5.2		27	4.7	5.0	4.7	4.8	5.0	
12		4.6	5.6	4.7	5.1		28	4.8	4.8	4.7	4.8	5.1	
13		4.8	5.5	4.6	5.1		29	5.7	4.8	4.7	4.8	5.2	
14	7.5	4.6	5.4	4.5	5.0		30	5.5	4.7	4.6	4.7	5.9	
15	7.6	4.6	5.2	4.5	5.0		31	5.2	4.6		4.6		
16	7.3	4.8	5.3	4.5	5.0								

KANKAKEE RIVER AT MOMENCE, ILL.

This station was established February 22, 1905. It is located on the highway bridge in Momence, Ill., about one-half mile below the Chicago and Eastern Illinois Railway bridge.

The channel is straight for 700 feet above and below the station. Both banks are high, rocky, and do not overflow. The bed of the stream is composed of solid limestone rock, is free from vegetation, and is permanent. The river at this station is divided by an island, which begins about a mile above the bridge and terminates about 500 feet below. There are two channels at all stages, broken by the piers of the bridge. The left channel, in which most of the water flows, is admirably adapted to measurements at low water; the right channel is wide, with a rougher bed, which may affect the accuracy of measurements made at any stages of water above the ordinary. The current is swift. There are no dams or falls in the vicinity.

Discharge measurements are made from the five-span bridge to which the gage is attached. Two spans of the bridge are over the south and three spans over the north channel. The initial point for soundings in the south channel is 1 foot to the left of the inner face of the left abutment; that for the north channel is 1 foot to the left of the inner face of the left abutment.

A standard chain gage, which was read during 1905 by J. L. Clark, is attached to the downstream side of the second span from the left bank. The length of the chain from the end of the weight to the marker (end of copper chain) is 17.66 feet. The gage is referred to bench marks as follows: (1) Top of the city hydrant one block south of the highway bridge; elevation, 12.40 feet. (2) Northeast corner of north abutment of the south bridge; elevation, 13.93 feet. (3) Momence city bench mark, on the water tablet located

on the northwest corner of the Central House; elevation, 14.62 feet. All elevations are above datum of gage, which is 5.38 feet above Momence city datum. The city datum is 607.06 feet above mean sea level.

Discharge measurements of Kankakee River at Momence, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 22	F. W. Hanna	481	261	1.40	2.90	[a] 365
March 13	S. K. Clapp	482	941	2.91	2.78	2,737
May 11	M. S. Brennan	492	1,197	3.32	3.35	3,974
May 15	F. W. Hanna	406	1,513	3.55	3.95	5,370
June 25	M. S. Brennan	485	845	2.45	2.65	2,072
July 29	do	463	577	1.98	2.18	1,140
August 26	do	442	450	1.52	1.96	685
September 12	do	459	598	1.97	2.19	1,179
October 6	do	431	414	1.43	1.78	598

[a] Ice measurement.

Daily gage height, in feet, of Kankakee River at Momence, Ill., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.8	3.15	2.9	3.5	2.55	2.05	1.8	1.92	1.8	2.05
2		3.9	3.15	2.9	3.35	2.5	2.05	2.7	1.9	1.8	2.05
3		3.8	3.1	2.9	3.2	2.5	2.0	3.05	1.9	1.8	2.15
4		3.6	3.1	3.0	3.25	2.45	2.0	2.85	1.85	1.8	2.1
5		3.8	3.05	3.0	3.25	2.4	2.0	2.6	1.82	1.82	2.25
6		3.9	3.05	3.0	3.05	2.4	2.0	2.42	1.8	1.92	2.05
7		4.5	3.0	2.95	2.9	2.32	1.98	2.32	1.75	1.95	2.0
8		2.6	2.9	2.9	2.8	2.3	1.95	2.22	1.75	1.95	2.1
9		2.7	2.9	2.9	2.7	2.38	1.95	2.2	1.7	1.95	2.3
10		2.7	2.85	2.85	2.8	2.42	1.9	2.2	1.75	1.95	2.3
11		2.8	2.85	3.4	3.3	2.5	1.9	2.2	1.75	1.95	2.0
12		2.8	2.8	4.5	3.25	2.48	1.82	2.2	1.72	1.95	2.3
13		2.8	2.75	4.4	3.1	2.4	1.9	2.2	1.7	[a] 1.95	2.35
14		2.8	2.7	4.2	3.0	2.32	2.0	2.2	1.7	1.95	2.1
15		2.8	2.7	[a] 4.0	2.8	2.25	2.08	2.2	1.7	1.95	1.95
16		2.8	2.6	3.85	2.7	2.2	2.05	2.2	1.7	1.95	2.05
17		2.9	2.55	3.95	2.6	2.13	2.0	2.25	1.7	1.98	.....
18		3.0	2.5	3.95	3.0	2.12	1.95	2.25	1.72	2.0	.....
19		3.05	2.5	3.85	3.0	2.15	1.95	2.22	1.78	2.0	.....
20		3.05	2.65	3.8	2.8	2.18	2.0	2.2	1.8	2.0	.....
21		3.0	3.15	3.7	2.75	2.2	1.95	2.2	1.75	2.0	.....
22		2.9	3.2	3.6	2.75	2.2	1.95	2.15	1.78	1.95	.....
23		2.9	3.1	3.55	2.7	2.2	1.9	2.1	1.8	1.95	.....
24	2.95	3.15	3.0	3.5	2.7	2.2	1.9	2.1	1.8	1.95	.....
25	3.1	3.2	2.9	3.45	2.65	2.2	1.9	2.02	1.8	1.95	.....
26	3.7	3.2	2.9	3.7	2.65	2.2	1.88	2.0	1.8	1.95	.....
27	3.8	3.1	3.0	3.75	2.7	2.2	1.8	2.0	1.8	1.95	.....
28	3.6	3.05	3.0	3.6	2.7	2.2	1.8	1.95	1.8	2.0	.....
29		3.1	3.0	3.5	2.6	2.2	1.75	1.95	1.8	2.05	.....
30		3.1	3.0	3.6	2.6	2.2	1.75	1.9	1.8	2.05	.....
31		3.1	.....	3.55	.....	2.12	1.78	.....	1.8	.....	.....

[a] Gage height interpolated.

NOTE.—No ice record for this station.

Station rating table for Kankakee River at Momence, Ill., from February 24 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	310	2.40	1,590	3.20	3,460	3.90	5,300
1.70	410	2.50	1,810	3.30	3,710	4.00	5,570
1.80	520	2.60	2,030	3.40	3,970	4.10	5,840
1.90	650	2.70	2,260	3.50	4,230	4.20	6,120
2.00	810	2.80	2,490	3.60	4,490	4.30	6,400
2.10	980	2.90	2,730	3.70	4,760	4.40	6,680
2.20	1,170	3.00	2,970	3.80	5,030	4.50	6,960
2.30	1,380	3.10	3,210				

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is fairly well defined between gage heights 2.1 feet and 4 feet. Below gage height 2.1 feet the table is uncertain, as the two lowest measurements are inconsistent.

Estimated monthly discharge of Kankakee River at Momence, Ill., for 1905.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
February 24-28	5,030	2,850	4,068
March	6,960	2,060	3,392
April	3,460	1,810	2,744
May	6,960	2,610	4,281
June	4,230	2,030	2,753
July	1,920	1,018	1,368
August	946	465	710
September	3,090	650	1,262
October	682	410	500
November	895	520	721
December 1-16	1,485	730	1,053

YELLOW RIVER AT KNOX, IND.

This station was established August 21, 1905. It is located on the North Heaton Street Highway Bridge, 100 rods north of the New York, Chicago and St. Louis Railroad.

The channel is straight for about 200 feet above and 300 feet below the station. Both banks are high and wooded and are liable to overflow at extremely high stages. At time of floods part of the water will pass through a small masonry arch about 100 feet to the right of the right abutment. The bed of the stream is composed of sand and is slightly shifting. The current is fairly swift.

Discharge measurements are made from the single-span highway bridge, downstream side. The initial point for soundings is the downstream inner face of the left abutment.

A standard chain gage, which was read during 1905 by William B. Shaw, is located on the floor of the bridge, downstream side. The length of the chain from the end of the weight to the marker is 19.62 feet. The gage is referred to bench marks as follows: (1) West end of top surface of north abutment; elevation, 15.20 feet. (2) Nails in trunk of double birch tree 60 feet west of west hand rail; elevation, 8.10 feet. (3) Top of west wing wall of south abutment; elevation, 14.50 feet. Bench marks Nos. 1 and 3 are painted red on the surface of the stones. Elevations are above gage datum.

Discharge measurements of Yellow River at Knox, Ind., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
August 21	M. S. Brennan	91	98	1.45	2.02	142
October 3	do	94	96	1.57	2.03	151

Daily gage height, in feet, of Yellow River at Knox, Ind., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.9	2.0	2.1	3.3	17		2.6	1.4	2.2	
2		2.5	2.0	2.0	3.5	18		2.7	1.8	2.2	
3		2.9	1.9	2.0	3.5	19		2.7	2.0	2.2	
4		3.0	1.9	2.1	3.5	20		2.9	2.4	2.2	
5		3.0	1.7	2.2	3.5	21	1.2	2.1	2.5	2.1	
6		3.0	1.6	2.3	3.4	22	1.2	2.1	2.6	2.1	
7		2.9	1.6	2.5	3.4	23	1.1	2.9	2.6	2.1	
8		2.7	1.6	2.6	3.4	24	1.1	2.9	2.5	2.2	
9		2.4	1.7	2.7	3.3	25	1.0	2.7	2.4	2.2	
10		2.4	1.7	2.9	3.1	26	1.0	2.4	2.3	2.3	
11		2.4	1.6	2.9	3.0	27		2.3	2.3	2.4	
12		2.3	1.6	2.9	2.8	28	1.3	2.1	2.3	2.6	
13		2.3	1.5	2.7	2.6	29	1.4	2.0	2.2	2.7	
14		2.0	1.4	2.5	2.6	30	1.7	2.0	2.2	3.0	
15		2.0	1.4	2.4	2.5	31	1.9		2.2		
16		2.4	1.4	2.3	2.6						

FOX RIVER AT SHERIDAN, ILL.

This station was established in September, 1905, by F. W. Hanna. It is located at the Glen Park highway bridge at Sheridan, Ill.

The channel is straight for about 1,000 feet above and 1,500 feet below the station. The current is medium. The right bank is high and rocky, sparsely wooded, and does not overflow. The left bank is low, sparsely wooded, and overflows during high stages, the water passing over the road. The bed of the stream is clean and permanent. There is but one channel, broken by the piers of the bridge. Depth of water at ordinary stage, 5 feet.

Discharge measurements are made from the upstream side of the two-span steel highway bridge, which has a total length of 206 feet. There is also a timber trestle approach, 52 feet long, on the left bank. The initial point for soundings is the inner face of the right abutment, at the top, on the upstream side. Measurements should be good up to the stage at which the river overflows the left bank. Flood measurements may be taken from the railroad bridge 50 rods downstream.

A standard chain gage is fastened to the guard rail of the bridge on the downstream side; length of chain, 28.09 feet. During 1905 the gage was read once each day by Robert H. Campbell. Bench marks were established as follows: (1) A red-paint mark and the letters "U. S. B. M." on top of the clyindrical abutment pier supporting the end of the first span of the bridge at the left bank; elevation, 23.05 feet. (2) Point of the top of a flat rock on the right bank, 29.3 feet west of the initial point for soundings; elevation, 31.70 feet. Elevations refer to the gage datum.

Discharge measurements of Fox River at Sheridan, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
September 19	Hanna and Brennan	199	1,020	1.08	4.05	1,[illegible]
October 31	M. S. Brennan	199	1,005	1.07	4.12	1,07[illegible]

Daily gage height, in feet, of Fox River at Sheridan, Ill., for 1905.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		3.65	4.0	3.95	17		3.5	3.85	
2		3.55	3.9	3.9	18		3.75	3.9	
3		3.6	3.85		19		4.1	3.9	
4		3.55	3.85		20	4.05	4.35	3.8	3.65
5		3.55	3.9		21	3.95	4.25	3.95	
6		3.45	3.85	4.1	22	3.9	4.25	3.9	
7		3.45	4.1		23	3.95	4.3	3.9	
8		3.4	4.05		24	3.85	4.25	[a] 3.85	
9		3.3	4.0		25	3.75	4.45	3.8	
10		3.5	3.95		26	3.7	4.4	3.65	
11		3.6	3.9		27	3.8	4.35	3.45	3.7
12		3.5	3.9		28	3.75	4.3	4.05	
13		3.45	3.75	3.5	29	3.7	4.2	4.2	
14		3.45	4.0		30	3.7	4.05	4.15	
15		3.4	3.95		31		4.15		
16		3.4	3.95						

[a] Gage height interpolated.

NOTE.—River frozen December 3-31. Gage heights are to water surface in a hole in the ice.

SANGAMON RIVER AT DECATUR, ILL.

This station was established April 29, 1905. It is located at the "Cowford" Bridge on East Cantrell street, Decatur, Ill.

The channel is straight for 500 feet above and 1,000 feet below the station. Both banks are low, covered with some brush and willows, and subject to overflow, but all the water passes between the abutments of the bridge, as the roadway is high. The bed of the stream is composed of clay and rocks, is free from vegetation, and is permanent. The current is sluggish. About one-fourth mile below the bridge is a fordway, and several miles below the station is a small dam, used to impound water for the city water supply.

Discharge measurements are made from the downstream side of the single-span steel bridge to which the gage is attached. Low-water gagings are best made by wading at the ford, one-fourth mile below the bridge. The initial point for soundings is the face of the left abutment, downstream side, marked with a circle on the guard rail and post of the bridge.

A standard chain gage, read by Miss Hattie Devore, is fastened to the floor of the bridge, downstream side. The length of the chain from the end of the weight to the end of the chain proper is 28.01 feet. The gage is referred to bench marks as follows: (1) Top of bottom chord of truss of bridge opposite the weight of the gage, downstream side; elevation. 26.84 feet above datum of gage. (2) Top of the downstream corner of the right abutment at the bridge seat.

This station was discontinued September 10, 1905.

Discharge measurements of Sangamon River at Decatur, Ill., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 29	S. K. Clapp	128	973	0.81	10.12	788
May 18	do	120	312	.66	8.82	555

Daily gage height, in feet, of Sangamon River at Decatur, Ill., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May	June.	July.	Aug.	Sept.
1	.....	9.8	7.7	6.2	6.0	5.8	17	.....	9.6	7.4	7.9	6.0	.....
2	.....	9.2	7.5	6.3	6.1	5.9	18	.....	8.8	7.2	7.5	5.9	.....
3	.....	8.9	7.4	6.3	6.2	6.6	19	.....	8.5	7.0	7.3	5.9	.....
4	.....	8.5	7.2	6.8	6.1	6.2	20	.....	8.2	6.7	7.0	5.8	.....
5	.....	8.5	6.9	6.9	6.2	6.0	21	.....	7.9	6.6	7.2	5.8	.....
6	.....	9.0	6.8	8.1	6.1	5.9	22	.....	7.7	6.7	6.8	5.9	.....
7	.....	9.4	6.7	8.2	6.0	5.8	23	.....	7.4	6.6	6.7	5.9	.....
8	.....	9.2	6.8	8.3	6.0	5.8	24	.....	7.4	6.5	6.5	6.0	.....
9	.....	8.9	6.7	8.0	6.0	5.8	25	.....	7.1	6.7	6.4	5.9	.....
10	.....	8.7	6.5	8.9	5.9	5.9	26	.....	7.2	6.6	6.3	5.8	.....
11	.....	8.3	6.8	9.4	5.8	.....	27	.....	7.0	6.4	6.2	6.0	.....
12	.....	8.2	7.3	9.8	6.0	.....	28	.....	7.0	6.5	6.4	5.9	.....
13	.....	8.8	8.4	9.4	6.0	.....	29	10.1	7.1	6.3	6.2	5.8	.....
14	.....	9.8	8.7	9.5	6.0	.....	30	10.0	7.6	6.3	6.3	5.9	.....
15	.....	10.6	8.0	9.0	6.0	.....	31	.....	7.9	.....	6.1	5.8	.....
16	.....	10.7	7.8	8.4	6.0	.....							

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16, Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

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THE DIRECTOR,
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